SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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FRIDAY, FEBRUARY 21, 1902.

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THE STORY OF THE ESTABLISHMENT OF THE NATIONAL BUREAU OF STANDARDS.

THE passage of a bill, during the closing days of the last session of Congress, providing for the establishment of a National Bureau of Standards, came as a surprise to many. As the work of this bureau ought in the future to have a large bearing upon science and industry it may not be without interest to record the circumstances under which this legislation was effected, and to bring to the attention of those who in the future may be interested in the matter the names of a few men who, though not men of science, gave their time and labor heartily in the interest of this work. It has so happened that, although my own part in this has been very small, the circumstances have been known to me.

The National Bureau of Standards, as the new title reads, grew out of what has been called for many years the Office of Weights and Measures. In the early thirties large discrepancies were discovered in the weights and measures of the United States in the various custom-houses, and Congress authorized the Secretary of the Treasury to establish a shop for the manufacture of uniform standards. In 1836 provision was made for similar standards for the different states, and the 'Office of Standard Weights and Measures' was established.

The Office of Weights and Measures while in law a separate bureau of the Treasury Department, has been practically a part of the United States Coast and Geodetic Survey, and has been, since its organization, under the direction of the superintendent of that bureau. During its existence standards of weights and measures have been furnished to most of the states, and a great impetus has been given to the adoption by international agreement of the metric system. In its custody are kept the international kilogram and meter, and it has for years done a valuable work in the standardizing of steel tapes, thermometers and similar measuring instruments; while more recently it has begun the standardizing of electrical instruments.

On coming to the Coast Survey in 1897 I found the Office of Weights and Measures engaged in the work which I have just mentioned. In its service were two scientific assistants, an instrument maker and a messenger, and a small appropriation was made for office expenses. The work was under the charge of a field officer of the Coast Survey. The arrangement by which a field officer was in this way detailed temporarily for this duty did not seem to me good administration; it deprived the Coast Survey of the service of a much-needed officer, and in addition there was required for this duty not a surveyor but a physicist. I therefore asked Congress to appropriate a salary sufficiently large to induce a physicist of high standing to take charge of the office, under direction of the superintendent. An appropriation of $3,000 was made. With this sum some difficulty was found in inducing any physicist of standing and reputation to accept the place, and only after many interviews and considerable correspondence I succeeded in persuading Professor S. W. Stratton, of the University of Chicago, to become a candidate. The appointment to the position was made after competitive examination.

Mr. Stratton, after coming to the bureau, was instructed to make a report upon the work and efficiency of the office as then constituted, and to recommend, if it seemed advisable, a plan for its enlargement into a more efficient bureau of standards, which might perform in some measure for this country the work carried on by the Reichsanstalt in Germany.

Mr. Stratton entered heartily into this work, and the outcome of his examination was the preparation of a scheme for a National Bureau of Standards. This plan, after being discussed in the office of the Coast Survey, and receiving the criticism of Assistant Superintendent Tittmann and others acquainted with the history of such work abroad, was submitted to a number of physicists, chemists and manufacturers of the country. After their criticisms had been digested a final plan for the bureau was drawn, which is practically that submitted to Congress. In all of this work Mr. Stratton endeavored to avail himself not only of the criticism of those at home, but also of the work which has been done abroad; and the bureau as finally planned is not intended to be simply a copy of the Reichsanstalt, but a standardizing bureau adapted to American science and to American manufacture.

When the final plan had in this way been agreed upon, it was incorporated into a bill and placed before Secretary Gage and Assistant Secretary Vanderlip of the Treasury Department. The idea at once commended itself to their judgment, and Secretary Gage entered most heartily into a study of the purpose of the proposed bureau, and of the relations which it might have with industry, with commerce and with science. Supported by his hearty advocacy the bill went to the house and was

referred to the committee on Coinage, Weights and Measures. The measure was before this committee two sessions, and received from its members long and serious consideration. There appeared before the committee at one time and another, not only men of science, but manufacturers and engineers who were competent to speak on such matters. Amongst all those who appeared in favor of the bill, both before the committee of the House and the committee of the Senate, there was none whose opinion had more weight than that of the Secretary of the Treasury, Mr. Gage. The following extract from his testimony before the Senate committee is worth remembering in the history of this matter as the suggestion of a high officer of the government who appreciated not only the direct commercial results of the measure, but also its indirect moral effect:

> There is another side to this which occurs to me. It may appear to many to have a more sentimental than practical value, but it gives the proposition, to my mind, great force, and that is what might be called the moral aspect of this question; that recognition by the government of an absolute standard, to which fidelity in all the relations of life affected by that standard is required. We are the victims of looseness in our methods; of too much looseness in our ideas; of too much of that sort of spirit, born out of our rapid development, perhaps, of a disregard or a lack of comprehension of the binding sanction of accuracy in every relation of life.
>
> Now, the establishment of a bureau like this, where the government is the custodian and the originator of these standards of weights and measures as applied to all the higher scientific aspects of life which we are so rapidly developing in, has, to my mind, a value far and above the mere physical considerations which affect it, although those physical considerations are fundamental and most important. Nothing can dignify this government more than to be the patron of and the establisher of absolutely correct scientific standards and such legislation as will hold our people to faithfully regard and absolutely obey the requirements of law in adhesion to those true and correct standards.

The bill for the establishment of the bureau received at the hands of the Committee on Coinage, Weights and Measures a consideration seldom given to such a measure, and when it was finally reported it received from that committee on the floor of the House a support which indicated their appreciation of its importance and value. In particular the names of the chairman of the committee, Hon. James H. Southard, of Ohio; and Hon. John F. Shafroth, of Colorado, deserve special mention. In the closing days of the fifty-sixth congress, when it was doubtful whether the speaker could permit consideration of the measure, Mr. Southard kept his seat day after day, and even night after night, in order that no opportunity might slip by when the speaker might be able to recognize him for the passage of the bill. In the splendid new building which Congress has provided for the housing of this bureau, and which is to become in the future the home of the great influence which it will exert on science and on industry, two names of those who had to do with its successful inception, so far as legislation is concerned, may well be placed high on its walls; and these are the names of Lyman J. Gage, Secretary of the Treasury, and James H. Southard, Chairman of the Committee on Coinage, Weights and Measures.

In the Senate, also, the bill received friendly consideration at the hands of the Committee on Commerce.

Looking back over the history of this legislation, which was effected without the help of any lobby, at the recommendation of a few men qualified to speak on such matters, it is evident that it has been the result, in the first place, of the work of those who founded the Office of Weights and Measures; of the influence of the scientific recommendations of the last twenty years looking toward the enlarge-

ment of that bureau, and of the intelligent interest of the Secretary of the Treasury and of the Chairman of the Committee on Coinage, Weights and Measures. And finally, but by no means least in importance, the successful outcome is due to the intelligent way in which this bill was placed by Mr. Stratton before the committees in the House and in the Senate. The enactment of such a measure ought to reassure scientific men in their judgment of the relation of Congress to legislation in such matters, since it shows that such legislation can be had without the help of any lobby, without the stimulus of personal interest on the part of Congress, if there is presented a clear and satisfactory reason for such legislation by those in whom Congressmen themselves have confidence.

Another feature of this bureau, which is unique, will also be watched by scientific men, as time goes on, with great interest, and that is the provision under which a visiting committee of five men, not connected with government service, report each year on the efficiency and needs of the bureau. I shall be greatly disappointed if this does not have a wholesome effect on the bureau itself, and on the relations of the bureau with Congress and with the department. It is scarcely possible that a Secretary of the Treasury will dismiss from office a competent head of the bureau who is supported courageously by this committee, nor will he appoint to the office of director a man whom they consider incompetent and unsuitable. If out of this relation there comes a wholesome criticism and a quickening of the scientific spirit, one may well hope that this feature may find a place in other departments of government scientific work.

Henry S. Pritchett.

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.

II.

The Constant of Aberration: C. L. Doolittle.

For some time a revision of the latitude work carried on at the Sayre Observatory, Bethlehem, Pa., from 1876 to 1895, has been in progress with the view to its publication in a complete and final form. The first fasciculus of this publication appeared in the spring of 1901 and it is hoped that the remainder may be in form for the printer in the course of two or three months.

The present communication deals primarily with the value of the constant of aberration resulting from the series of observations extending from October 10, 1892, to December 27, 1893. A preliminary solution of the problem was published in the *Ast. Journal,* No. 406, 1897, which may be consulted for a fuller statement as to the method employed. The micrometer screw had become much worn by constant use for several years and the value was not constant throughout the series. Also the progressive errors which had been previously determined by means of Harkness' measuring engine were no longer applicable. It seemed very desirable that the screw value should be derived from the latitude observations themselves, but at the time spoken of the star declinations were not known with the requisite precision. For these reasons there was some hesitation as to the desirability of publishing the preliminary result, as it was thought possible that a considerable error might be involved. Recently a very careful discussion of the declinations has furnished the required data, and a result obtained which seems entirely free from the above named objections.

From the method of observing it is not possible to separate the correction to the aberration constant from the latitude vari-

ation without introducing an assumption with respect to one or the other. It has accordingly been assumed that the latitude variation can be represented by two periodic terms of 14 and 12 months, respectively. Each observed latitude, therefore, gives an equation of this form

$$x \sin N + y \cos N + z \sin \odot + u \cos \odot + E_\rho + T\mu + \Delta\phi + \phi_0 = \phi$$

where N is the 14-month term, E_ρ the correction to the aberration and T_μ secular change in the latitude.

The evening and morning observations furnish 1,744 and 1,052 equations of this form, respectively. These were solved retaining all terms. Then another solution was made excluding the annual term, as it is obvious that this can not be separated from the 14-month term in a series embracing a period of less than 16 months. The resulting value of the constant of aberration from both the preliminary and revised solution is as follows:

	Preliminary.	Revised Solution.
1st solution,	$20''.552 \pm .0095$	$20''.551 \pm .0092$
2d "	$20\ .555 \pm .0093$	$20\ .552 \pm .0090$

It thus appears that the suspected error in the preliminary reduction was a vanishing quantity.

Two other series of observations made at the Sayre Observatory have been employed for a similar investigation. The first, from December 1, 1889, to December 13, 1890, embracing 1,344 latitude determinations, was treated in a manner similar to that above described except that only one solution was made involving periodic term of 14 months. The resulting aberration constant is $20''.448 \pm .014$. It is doubtful whether this result is entitled to much confidence, the most serious objection being that the series does not cover a full term of 14 months, which is assumed for the period of latitude variation. The other series referred to extends from January 19, 1894, to August 19, 1895, the arrangement being that sometimes called the polygon method by which the aberration is obtained independently of the latitude variation. The result is $20''.537$. Other recent determinations are given for comparison:

Flower Observatory.

1896–98	$20''.580$
1898–99	20 .542
1900–01	20 .560

J. W. J. A. Stein, Leiden—Zenith Telescope.

1899–1900 ..... $20''.541 \pm .016$

Albrecht—International Latitude.

$20''.515$

Chandler from Pond's Observations.

1825–36 ..... $20''.512 \pm .019$

The Period of Delta Equulei: W. J. HUSSEY.

Delta Equulei enjoys the distinction of having a period shorter by nearly half than that of any other visual double star and in being at the same time a spectroscopic binary. The latter characteristic is due to the visible components. It therefore forms a connection between the visual and spectroscopic double stars. This pair was discovered in 1852 by Otto Struve and observed by him occasionally for thirty years. Burnham's observations from 1880 to 1883, inclusive, appeared to indicate a period of 10.8 years; the elements subsequently derived by Wroublewsky and by See gave nearly 11.5 years. Between 1899.85 and 1900.65 the components rapidly approached each other and the apparent distance was extremely small at the latter date. This rapid change in distance is not explainable on the hypothesis that the period is nearly 11.5 years, but is entirely in accord with one of about half this length. The elements derived by the writer a year ago have a period of 5.7 years. From these elements he predicted that the components should separate to a measurable distance

this year and again close in. Observations show that this has happened. In July, 1901, the distance was approximately 0″.15. It has now decreased to less than 0″.05, or approximately the same as in the autumn of 1900. The data at present available appear to show that the period of 5.7 years is substantially correct.

The Duration of Twilight within the Tropics: S. I. Bailey.

The atmosphere renders many services to man. Not the least of these, perhaps, is the twilight. If there were no atmosphere, there would be no twilight, and the brightness of midday would be succeeded, the moment after sunset, by the darkness of midnight. Such a condition of affairs would cause considerable inconvenience. Twilight may be said to last until the last bit of illuminated sky disappears from the western horizon. In general it has been found that this occurs when the sun has sunk about 18° below the horizon. The duration of time which the sun takes in reaching this position is very different at different latitudes. At the North Pole one would have about six months of daylight, followed by nearly two months of decreasing twilight, followed in turn by more than two months of night. In summer, at latitudes greater than 50°, twilight lasts from sunset to sunrise. There is no night there, during this season. In the temperate zones the duration of twilight ranges from an hour and a half to more than two hours. Within the tropics the sun descends nearly or quite vertically; but even here the time required for the sun to reach a point 18° below the horizon is more than an hour. There seems to be no reason, therefore, in the general theory, for the widespread belief that the duration of the tropical twilight is extremely brief. This idea is found not only in current popular literature, but also in some of the best text-books on general astronomy. Young's 'General Astronomy,' p. 69, says: "At Quito and Lima it (the twilight) is said to last not more than twenty minutes." Why Quito should be classed with Lima I do not know, except that both are within the tropics. 'The Heavens Above,' by Gilbert and Rolfe, remarks: "Within the tropics, where the air is pure and dry, twilight sometimes lasts only fifteen minutes." Since Arequipa, Peru, lies within the tropics and has an elevation of 8,000 feet, and the air is especially pure and dry, the conditions appear to be exceptionally favorable for an extremely short twilight. On Sunday, June 25, 1899, the following observations were made at the Harvard Astronomical Station, which is situated there: The sun disappeared at 5:30 P.M., local mean time. At 6:00 P.M., 30 m. after sunset, I could read ordinary print with perfect ease. At 6:30 P.M. I could see the time readily by an ordinary watch. At 6:40 P.M., 70 m. after sunset, the illuminated western sky was still bright enough to cast a faint shadow of an opaque body on a white surface. At 6:50 P.M. the illumination was faint, and at 6:55 P.M., 1 h. and 25 m. after sunset, it had disappeared. On August 27, 1899, the following observations were made at Vincocaya. The latitude of this place is about 16° south, and the altitude 14,360 feet. Here it was possible to read coarse print 47 m. after sunset, and twilight could be seen for an hour and twelve minutes after the sun's disappearance. It appears, therefore, that while the tropical twilight is somewhat shorter than occurs elsewhere, and is still further lessened by favorable conditions, such as great altitude, and a specially pure air, it is never less, and generally much longer, than an hour.

The Determination of Double Star Orbits: George C. Comstock.

The usual data for the determination of

a double star orbit consist of a series of observed position angles and distances with the corresponding times of observation. From this data it is customary to derive the apparent orbit of the star by plotting the observed coordinates and drawing through the resulting points the best ellipse that can be fitted to them, subject to the condition that in this ellipse the radius vector must sweep over equal areas in equal times. The author knows no published statement showing how this condition is applied in the actual construction of the ellipse and it is not apparent how it can be applied in any satisfactory manner in this purely graphical process. Moreover, the process is open to the additional objection that it takes small account of the circumstance that of the three elements entering into a complete double star observation, position angle, distance and epoch, the time of observation is determined with a precision incomparably superior to that of the measured coordinates, and should therefore play a prominent part in the determination of the orbit instead of the subordinate rôle commonly assigned it. The method proposed for improving the current practice in these respects reverts to the practice introduced by Sir John Herschel, of plotting the observed position angles with the corresponding times as abscissæ, and extends the same practice to the observed distances. From the resulting curves data are derived for assumed epochs, and through a least square adjustment supplemented by mechanical quadratures are transformed into normal places that satisfy rigorously the condition of constant areal velocity. A partial control upon the character of the data and the treatment to which they have been subjected is furnished by the quasi rigorous condition that the adjusted normal places shall all lie upon some ellipse. In the adjustment of the data there is incidentally determined the areal velocity of the radius vector and this in connection with the apparent orbit, plotted from the normal places, leads immediately to a determination of the periodic time and to the independent determination of the dates of periastron and apastron passage. The agreement of the double interval between these dates with the periodic time first determined furnishes a partial check upon the work. The transition from the apparent to the real orbit may be made by any of the standard methods, but that of Klinkerfues when simplified by the introduction of the elements above derived is especially convenient. There was presented an application of the method above outlined to the determination of the orbit of Struve 2,107, showing that the labor involved does not greatly exceed that of the ordinary methods and is fully compensated by the checks furnished *en route* as well as by the increased precision of the results.

A Cosmic Cycle: FRANK W. VERY.

An application of a new doctrine of an explosive condition of matter (limited by composition, pressure and temperature) to various phenomena of the heavenly bodies, and to stellar evolution. Novæ are regarded as the culmination of long-enduring antecedent stages of stellar preparation, and as indicating (along with the helium stars) a condition of instability and active modification which is incompatible with planetary growth, but which is followed by other relatively quiescent stages favorable to the production of planets and to their orderly development. An extension of the doctrine of the conservation of energy is involved, and the problem of the sustentation of solar heat is approached from a new standpoint which admits of a great extension in the duration of the solar system, thus satisfying the demands of the geologist for a prolonged terrestrial

duration. (The paper will appear in full in the *American Journal of Science*.)

A Comparison of Printing and Recording Chronographs: C. S. Howe.

A printing chronograph, to be of any value to astronomers, should be easily set and regulated; it should run several hours without any attention; it should have a small probable error; its results should agree, or differ by a constant amount each night, with the results from the recording chronograph. Several months' experience with the Hough printing chronograph at the Case Observatory shows that the instrument can be easily set and adjusted and that it runs several hours without any attention. The probable error of one record was found to be ± .011 seconds, and the probable error of the mean of nine wires ± .004 seconds. Similar tests with the recording chronograph give respectively ± .006 and ± .002 seconds. These errors are so small that they can be neglected. A direct comparison of the two chronographs showed an average difference between them of .025 seconds, the printing chronograph making the record first.

The Clock Room at the Case Observatory: C. S. Howe and E. H. Brown.

The clock room is a room built of tile within one of the rooms of the basement of the Physical Laboratory. The basement is warmed in the daytime, but not at night. The space outside the clock room is warmed by two gas stoves, the gas being turned on or off by an automatic burner which is regulated by a thermostat made of steel and hard rubber. This controls the temperature outside the clock room within one degree centigrade and inside the clock room within about one half degree. The inside temperature is further controlled by another thermostat, which by means of a relay throws in or out one or more electric lamps, the heat of which changes the temperature. This arrangement keeps the temperature within one tenth of a degree. The hourly rates of a Riefler clock, enclosed in a glass case from which the air is partially exhausted, were also given.

The Almucantar as an Instrument for the Determination of Time: C. S. Howe.

In 1885 Dr. Chandler compared the clock corrections determined with a small almucantar with those determined with the large Transit Circle of the Harvard Observatory. The Case Almucantar is a large instrument with a six-inch object glass. It was not possible to compare it with a large transit and so its value for the determination of time could only be determined by the consistency of the several results obtained on any one night and by the excellent and nearly uniform clock rates determined by it. The differences between the several values of the clock corrections on any one night were usually not more than two or three hundredths of a second and the greatest difference since June, 1901, was 0.13 of a second.

A Description of the Second (Chile) Mills Spectrograph: W. W. Campbell.

The mechanical features of the instrument and its method of support are radically different from those of the conventional spectrographs. The entire framework is composed of a single steel casting with webs and flanges bracing it thoroughly in every direction and with especial reference to the supports near its two ends. The slit, the prism box, the camera and the collimator and camera lenses are all fixed directly to the casting. A reflecting slit is used, curved to make the spectrum lines straight. The weight of the entire spectrograph is about 75 pounds. The instrument is mounted in a supporting cradle composed of tee and channel steel bars in such a way that it will rest on two points (a plane and a ring) near the two ends of

the instrument, respectively. Strains in the supporting cradle cannot induce strains in the spectrograph. The old method of supporting spectrographs entirely from one end, allowing the other end to project unsupported out into space, invites flexure effects, and it is hoped that the new method of support will prove to be a radical improvement. The whole spectrograph will be moved to bring the slit into the focus of the Cassegrain telescope. A temperature case similar to the one used for the past three years on the original Mills spectrograph will enclose the instrument.

On the Capture of Comets by Jupiter: PERCIVAL LOWELL.

This paper gave in diagrams a part of the author's memoir on the subject, not yet published, in which he explained the action of Jupiter upon a comet entering the planet's sphere of activity, and the relation borne by the direction and the speed of approach to the comet's subsequent behavior. The paper showed that Jupiter was not only capable of transforming at one encounter a parabolic comet into an elliptic one of about half his own major axis, but could actually cause a comet to make the planet instead of the sun the goal of its visit, and send it back again into space without circumnavigating the sun at all. The argument then developed a critical angle differentiating those comets which Jupiter's action might render retrograde from such as it could not. A table here showed that the angle of approach of each of the comets composing Jupiter's comet family not only at the present moment fell within the critical angle for each, but must do so for all time, abstraction made of perturbations by other bodies and the approximation being of the first order. In other words, that under these conditions the present direct motion of all the members of Jupiter's comet family was such in perpetuity. The planet might drive them off into space but could never render any of them retrograde.

The Latitude-Variation Observatory of the International Geodetic Association: HERMAN S. DAVIS.

A brief statement of the plan of the International Association in the establishment of the four stations at Gaithersburg, Maryland, Ukiah, California, and in Japan and Sardinia for a systematic and continuous series of observations for the study of variations of latitude. Particular attention was given to the two stations in the United States under the general direction of the Coast and Geodetic Survey, the one in charge of Dr. Schlesinger, at Ukiah, and the other in charge of the speaker, at Gaithersburg. Illustrations with the lantern were shown of both these stations with plans of the buildings and views of the telescope at Gaithersburg. Attention was called to the admirable quality of the observations made by Mr. Edwin Smith, who was in charge of the station at Gaithersburg prior to January, 1901, and entire credit given him for the erection of the buildings and installation of the instruments at this station, and to the active and enthusiastic support of the superintendent of the Coast Survey from the very inception of the plan to establish these stations in the United States.

Some Vices and Devices in Astronomical Computations: HERMAN S. DAVIS.

Owing to the briefness of the time requested for the presentation of this paper and the fact that a considerable portion of that time was devoted to the preceding paper which was presented by request—not being regularly on the program—the speaker gave only a meager description of some of the methods which he is now using in the new reduction of the 160,000 star-

observations made by Piazzi at Palermo between 1792 and 1813. Particular attention was directed to only one of the many devices which have been applied for shortening the computations whereby already the work is two years ahead of the schedule outlined at the beginning of the undertaking, that device being the use of specially constructed table of limiting-values instead of such logarithm or anti-logarithm or other tables as appear in print. Illustrations of these special tables and their application and data as to the percentage of time saved by their use were also given. Another one of the devices has already been published in *Astronomical Journal*, No. 498 (XXI.:143–4), and a number of others, of which mention was omitted for lack of time and the lantern slides which had been designed (but unexpectedly delayed) for their proper exposition will be put into print at some future date.

Observations of Meteors, November 13–16, 1901: J. K. Rees.

As in previous years, I observed with Mr. Charles A. Post from his observatory at Bayport, Long Island. We arranged (1) to photograph meteor trails with four cameras mounted on the equatorial which was driven by an excellent clock, (2) to count the meteors and (3) to record individual meteors which exhibited striking peculiarities.

1. The equatorial and cameras employed are shown in Plate II., *Popular Astronomy* (No. 82), February, 1901.

The apertures and focal lengths are given in the following table:

Instrument.	Aperture.	Focal length.
Equatorial telescope.	6 inches.	90 inches.
Willard photographic doublet.	5½ "	23 "
Darlot portrait.	1½ "	6½ "
Anthony portrait.	3 "	13½ "
Goerz wide angle double anastigmatic.	1½ "	9½ "

PHOTOGRAPHIC EXPOSURES.

Nov. 13. 12:00 to 18:00 (Eastern Standard time). A number of experimental plates were taken but no effort was made to photograph meteors, as so few were seen.

Nov. 14. 11:20 to 12:24. Exposed the Goerz lens pointed at the belt of Orion. 13:15 to 14:05. Exposed all the cameras pointed as follows: Willard and Anthony lenses at Procyon, Goerz lens at belt of Orion, and Darlot lens at μ and ε Leonis. At 15:00 the sky clouded but cleared again at 15:30. 15:42 to 16:30 all cameras were exposed. The Willard and Anthony on ε Leonis, the Goerz on ζ, ε, δ Hydræ, and the Darlot on Ursa Major.

The clouds began to spread over the sky again, and in a short time it was impossible to see a star, later it cleared. Observers then confined their attention to counting and observing the meteors.

Nov. 15. 11:45 to 13:00. Exposed all cameras. Willard and Anthony lenses on Pollux, Goerz lens on Procyon, and Darlot lens on γ Geminorum. 14:35 to 15:45. Exposed all cameras. Willard and Anthony on ζ Leonis, Goerz on Regulus, and Darlot on λ and μ Leonis Minoris. Clock did not work as well as usual. 16:01 to 17:00. Willard lens was omitted. The other cameras were pointed as in the preceding exposure.

Mr. Post developed all the plates. The plates taken on November 14 show a number of trails. Quite a remarkable meteor trail is shown on the plates taken with the Willard and the Anthony lenses between 15:42 and 16:30. The notes given under 'Record of Individual Meteors' seem to show that this meteor appeared at 15:58.

2. Count of Meteors.

Only during the night of November 14 was any careful attempt made to count. Miss Edith Post and Miss Greenough observed the eastern sky looking toward the radiant. At first both observed the same part of the sky, but after 38 had been counted Miss Greenough observed the southeastern sky from the line from the radiant to the zenith, and Miss Post ob-

served the northeastern sky from the same line. The count was as follows:

Nov. 14. 12:15 to 13:40. Miss Post and Miss Greenough, 38; Miss Post—northeastern sky, 31; Miss Greenough—southeastern sky, 31. 13:40 to 14:20. Messrs. Post and Rees looking out of the opening in the roof of the Observatory toward the radiant, 20. 14:20 to 15:00. Miss Post—northeastern sky, 10; Miss Greenough, southeastern sky, 15. 15:50 to 17:55. The Misses Post and Greenough counted being assisted from 16:30 to 17:55 by Post and Rees. The total count of the four observers was 273. Total for the evening, 418.

Nov. 15. Post and Rees assisted by Mr. Post's 'handy man' counted, while engaged on the photographic work and looking out of the observatory opening, as follows: 11:45 to 13:00. 25, several of which were non-Leonids. 14:35 to 15:45. 3 of which 1 non-Leonid. 16:01 to 17:00. 23, several non-Leonids.

Nov. 16. 12:00 to 17:00. Looked out frequently but saw so few that no record was kept.

3. Individual Meteors.

Nov. 14. 11:30. Two bright Leonids—trails yellow-red 10° long—width very distinct. 11:51. Leonid from Procyon to θ Orionis—blue streak. 12:07. From star above Procyon to 'yardstick'—trail 25° long—lasted several seconds—yellow—Leonid. 12:10. Leonid through Ursa Major—bright trail. 12:15. Leonid through Ursa Major. 12:17. Leonid through Auriga. 13:18. Brilliant Leonid, near radiant—very small trail—orange color—bright as Mars at best. 13:27. Fine Leonid from Leo to zenith—trail 30° long—yellow-red. 13:30. Leonid through Ursa Major—fine. 13:40. Meteor near Procyon—from zenith down—short trail. 13:44. Fine Leonid through bowl of dipper—trail 5°. 13:51. Leonid under Procyon—8° trail—yellow-red. 15:58. Brilliant Leonid—trail 5°—lasted twenty seconds—blue-white—1st magnitude. 16:04. Leonid under Procyon—blue-white—10° trail. 17:28. Two brilliant meteors visible at same time—trails crossed—bright heads. One came from radiant and passed near α and β Can. Ven.—trail 30° long and lasted several seconds. The second seemed to come from below β Leonis and cut the trail of the first under Canes Venatici—trail 30°. Magnitude of each—2.

Nov. 15. 14:52. Bright Leonid under Leo Minor. 15:37. Leonid bright as Jupiter—in sickle—blue and red trail. About 15:55. Fire ball below Leo came from Orion. 16:10. From zenith through Leo Minor (λ and μ)—long train 40°. About 17:00. The zodiacal light showed itself in a grandly beautiful manner.

A Theorem concerning the Method of Least Squares: HAROLD JACOBY.

The following theorem and conclusion are doubtless well known to many astronomers, but the writer has not found an explicit statement of them in print. Let there be given two series of observation equations as follows:

$$\left.\begin{aligned} a_1x + b_1y + c_1z + \cdots + n_1 &= 0 \\ a_2x + b_2y + c_2z + \cdots + n_2 &= 0 \\ \vdots \qquad\qquad & \vdots \end{aligned}\right\} \quad (1)$$

$$\left.\begin{aligned} a_1x + b_1y + c_1z + \cdots + p_1w + \cdots + n_1 &= 0 \\ a_2x + b_2y + c_2z + \cdots + p_2w + \cdots + n_2 &= 0 \\ \vdots \qquad\qquad & \vdots \end{aligned}\right\} \quad (2)$$

the equations being identical in the two series except for the addition of one or more new unknowns, w, . . . in (2). Let each series of equations be solved by the method of least squares, and let $[vv]_1$ be the sum of the squares of the residuals resulting from the solution of equations (1), $[vv]_2$ be the sum of the squares of the residuals resulting from the solution of equations (2); then, no matter what may be the law of the coefficients p_1, p_2, . . . , and even if these coefficients are assigned at random, $[vv]_1$ is always larger than $[vv]_2$.

Corollary.—The theorem can be extended easily to an additional case of equal importance. Instead of introducing the new unknowns w, . . . , by adding them to those already occurring in equations (1), we may select out certain equations from the series (1), and simply substitute new unknowns, like w, for old ones, like z, leaving the coefficients unchanged.

Conclusion.—The method of least squares is used ordinarily to adjust series of observation equations so as to obtain the most probable values of the unknowns. But

there is a subtler and perhaps more important use of the method; when it is employed to decide which of two hypothetical theories has the greater probability of really being a law of nature; or to decide between two methods of reducing observations. Cases abound in astronomy where the method of least squares is used for this purpose. It has been so employed, for instance, to decide whether stellar parallax observations should be reduced with equations involving terms depending on atmospheric dispersion, and terms depending on the hour-angle, to ascertain whether portable transit observations should be reduced on the supposition of a change of azimuth on reversal of the instrument (an application of the corollary), etc.

In such cases, astronomers not infrequently give preference to the solution which brings out the smallest value of $[vv]$, the sum of the squared residuals. But in the light of the above theorem, it becomes clear that the mere diminution of $[vv]$, alone is insufficient to decide between two solutions, when one involves more unknowns than the other. To give preference to the second solution it is necessary that the diminution of $[vv]$ be quite large, and that the additional unknowns possess a decided *a priori* probability of having a real existence.

The Nebula about Nova Persei, 1901: Frank W. Very.

The rapidly shifting and fast fading nebulosity around the new star is regarded as an evanescent phenomenon comparable to the tail of a comet. Velocities of propagation of different orders are surmised, but as there is no known motion of material particles, even when of the dimensions of negative ions, swifter than that of light, the latter may be taken as a limiting value of velocity, from which it is deduced that the distance of the nova can not exceed 750,000,000,000,000 miles, an estimate which gives us a first approximation to the distance of the Milky Way, since the novæ all belong to the galactic stream. An explanation of the meaning of the complex structure of the hydrogen bands in the spectrum of the nova is given, and a further cometary analogy is shown through the existence of concentric spherical envelopes near the star, resembling comæ, which are inferred from the structure of the spectral bands. From the spectral variations attending the formation and motion of these envelopes, the mass of the star is concluded to be about 1,150 times that of the sun; and as this mass does not appear to have been appreciably changed in the first month, in spite of the enormous outpourings of hot gases, it follows that the luminosity of the star is not conditioned by the mass or by the state of the star's internal activity; and it is suggested that the brightness of the star's continuous spectrum depends upon the formation or dissolution of clouds of cosmic dust in the spaces immediately surrounding the nova.

A Short and General Method of Determining Orbits from Three Observations: A. O. Leuschner.

The method is principally intended to aid in the rapid determination of an orbit from three observations, made at short intervals. It is essentially an improvement on Harzer's modification of Laplace's method contained in Méc. cél. T. I., première partie, livre II., Chap. IV. The first part of the paper deals with the discussion or Harzer's method. The modifications introduced by the author consist in: (1) The restriction of the number of observations to three, the minimum number necessary for the solution of the problem. (2) The reduction of the number of fundamental data to be approximated. In Harzer's method the fundamental data to be ap-

proximated are the heliocentric coordinates and their velocities, while in the present method they are the geocentric distance and the velocities of the heliocentric coordinates, all for the zero date. (3) A short method of obtaining preliminary values of the geocentric velocities and accelerations at the zero date. (4) A direct solution of the fundamental equation of the seventh degree in ρ_0, on the basis of von Oppolzer's table XIIIa ('Bahnbestimmung,' Vol. I.). (5) Differential formulæ for the determination of the final values of the heliocentric coordinates and velocities from which the elements are computed by Encke's formulæ. Chief among the advantages of the method here outlined are the ease with which such corrections to ρ_0, x_0', y_0', z_0' may be determined as will cause the residuals due to the original values of these quantities to disappear, and the possibility of determining these corrections directly from the residuals. On that account, it is of no great consequence if the originally adopted velocities and accelerations in α and δ are only approximate.

Elements of Asteroid 1900 GA and its Ephemeris for the Opposition of 1901–1902: A. O. LEUSCHNER and ADELAIDE M. HOBE.

This asteroid was discovered June 28, 1900, by the late director, James E. Keeler, of Lick Observatory, while photographing the region of the sky near Saturn with the Crossley Reflector. Trails were photographed on four days and point-images on two of these days. The problem of determining the orbit of the asteroid presents many points of interest and has led to the derivation of the 'Short and General Method of Determining Orbits from Three Observations.' The existing methods for determining orbits could not be used to advantage in this case, but the solution was successfully accomplished by means of the 'Short and General Method of Determining Orbits from Three Observations' outlined above. The magnitude of the asteroid at the present opposition (1902, Jan. 4) is $19.5 \pm .75$. The asteroid is, therefore, the faintest so far observed. The paper concludes with the discussion of the residuals of the measured positions of the termini of the trails relatively to the middle of the trails.

Discovery of Motion in the Faint Nebula Surrounding Nova Persei: C. D. PERRINE.

Early in the apparition of the new star in Perseus, short exposure photographs of it were secured with the Crossley Reflector by Messrs. H. K. Palmer and C. G. Dall. The first long exposure was secured on the nights of November 7 and 8. This negative had a total exposure of 7 h. 19 m. It was developed on the 9th, but owing to stormy weather was not dry and was not carefully examined until the morning of the 10th, when it was compared with the reproduction of a negative taken at the Yerkes Observatory on September 20 by Mr. Ritchey and published in the October number of the *Astrophysical Journal,* and the discovery at once made that several of the principal condensations in the nebula had moved to the southeast over a minute of arc in the interval. The main facts were embodied in a telegram which was sent to the Harvard College Observatory, for distribution to all observatories, at noon of November 10. A negative was obtained on the nights of November 12 and 13 with a total exposure of ten hours. A more rapid plate was used than on November 7 and 8 and with the longer exposure considerably more detail is shown. An exposure of 5 h. 28 m. was obtained on the night of December 4. As a storm came on, this plate was developed the following day. Considerable detail was shown on the negative and three

of the condensations were seen to have moved appreciably, while the strong one nearest the Nova showed but little if any change. An exposure of ten hours was secured on the nights of December 8 and 11, the 9th and 10th being cloudy. The motion of the nebula is so rapid that even in this interval of three days, blurring in the best-marked condensation is noticeable. A comparison of the last negative with that of November 12 and 13 reveals a number of changes. Condensations *A*, *B* and *C* (Lick Observatory Bulletin No. 10) have each continued their motions to the southeast full $\frac{1}{2}'$. Condensation *D* shows little or no change. Perhaps it is moving nearly in the line of sight. The negatives of December 4 and 8–11 show two new wisps of nebulosity southwest of the Nova at distances of 13′ and 14′, respectively. They are approximately arcs of circles of which Nova is the center and are about 2′ in length. They have been carefully looked for on the November negatives, but no traces are there found of them. Throughout the entire southeast quadrant faint nebulosity is shown to a distance of 18′ on the negative of December 8–11. There is but little appearance of structure in this outlying nebulosity. Several wisps of nebulosity 6′ to the north of Nova are sufficiently strong to show that motions outward of $\frac{1}{4}'$ to $\frac{1}{2}'$ have taken place in the interval of 27 days. A wisp 9′ to the north has also moved outward full $\frac{1}{2}'$. 6′ to the northwest of Nova is a wisp which has moved outward $\frac{1}{4}'$. None of these wisps to the north and northwest are well enough defined lengthwise to make the other component of motion certain in the interval. Directly to the west is an arrow-shaped mass of nebulosity resembling somewhat the structure of condensation *A*. It has certainly moved outward and there appears to have been a motion to the northwest. Many changes of form and intensity of masses of nebulosity have been noticed other than those referred to above, but which can not well be described. A longer series of photographs is necessary to deduce the character and amount of motion of these fainter masses. Lantern slides of the various photographs secured with the Crossley reflector were exhibited.

A Determination of the Wave Lengths of the Brighter Nebular Lines: W. H. Wright.

In the progress of our investigations upon the spectrum of Nova Persei (see Lick Observatory Bulletin No. 8) there arose the necessity for a more accurate knowledge than then existed of the wave lengths of the Brighter Nebular lines. The spectra of the Orion Nebula and of three of the brighter planetary nebulæ have been photographed in some cases with one prism, and in other cases with three prisms, and the resulting plates have been measured and reduced. The wave lengths of 16 bright lines have been determined with considerable accuracy, the fifth significant figure being determined definitely for the principal ones, and the uncertainty in the sixth place for the brighter lines being comparatively small. A slight correction appears to be needed in the values at present accepted for the positions of the two chief nebular lines determined by visual means. In the course of the work three new nebular lines have been discovered. The well-known lines usually described as H_ϵ and λ 3,727 have been found to be double.

A Determination of the Cause of the Discrepancy between Measures of Spectrograms made with Violet to Left and with Violet to Right: H. M. Reese.

In this paper three possible causes of the effect in question are investigated: (1) The curvature of the spectral lines; (2) the position of the star-spectrum in the

middle of the plate, enclosed by the comparison-spectrum; (3) a mere subjective tendency to set the cross-hair relatively farther to the right on a dark line in a white field than on a bright line in a dark field. The conclusion is reached that the third cause alone really operates, or at least that neither the curvature of the lines nor the relative position of star-spectrum and comparison affect the case.

Four New Spectroscopic Binaries: W. W. CAMPBELL.

Four stars have recently been observed with the Mills spectrograph to have variable velocities in the line of sight. These are φ Persei, ξ Herculis, α Equulei and υ Andromedæ. The first of these is an interesting bright-line star. The second has a large radial velocity, and is moreover an interesting visual double star whose period is about 33 years. This therefore affords another connection between visual and spectroscopic binaries. In the case of the third star, a composite spectrum was observed a few years ago by Miss Maury at Harvard College Observatory. Thirty-two spectroscopic binaries discovered with the Mills spectrograph in the past three years had previously been announced, thus bringing the number up to 36. On the list of suspected binaries are 14 stars, awaiting confirmation. Before the discovery of these binaries, 3 had been found in the same list of stars by Belopolsky, making about 40 spectroscopic binaries in 325 stars observed. The proportion is therefore one spectroscopic binary for every eight stars observed. The variable velocity of our sun, due to its revolving planets, has a double amplitude of only a few hundredths of a kilometer. As the work progresses and the degree of accuracy attainable increases, we shall probably find that there is a regular gradation of double amplitudes from that of our sun up to those of the spectroscopic binaries already discovered, and it is possible that the star that is not a spectroscopic binary will prove to be the rare exception. This field of investigation is one of extreme richness.

Discovery of Five Hundred New Double Stars: W. J. HUSSEY.

While observing the Otto Struve double stars the writer discovered new companions to five of them and also picked up several new pairs in the vicinity of others. This led to the notion of making an extended search for new pairs, which was begun as soon as it was possible to do so without interfering with the work in progress. In the spring of 1899 search was commenced in a tentative way and in July of the same year it was taken up regularly, and since then has been conducted in a systematic manner. While only a part of the writer's time has been devoted to the consideration of new double stars, he has now discovered and measured five hundred new pairs having distances under five seconds. The work has been done with both the twelve- and thirty-six-inch telescopes of the Lick Observatory. Many close and difficult pairs, some of them having distances less than a quarter of a second, have been found with the smaller instrument, but nearly all the measures have been made with the great telescope. The classification of the new pairs with respect to the distances between their components is as follows:

0″.25 or less,	37 pairs,
0 .26 to 0″.50,	96 pairs,
0 .51 to 1 .00,	112 pairs,
1 .01 to 2 .00,	112 pairs,
2 .01 to 5 .00,	143 pairs.

Seventy-one per cent. of the total number have distances under two seconds; 49 per cent. under one second; 27 per cent. under half a second; and seven and one-half per cent. under quarter of a second.

On the Discovery of 300 Double Stars: R. G. Aitken.

The writer's experience in observing double stars led him to conclude that it was desirable to make a systematic search for new pairs. As a contribution toward such a piece of work, 10,917 stars brighter than 9.1 magnitude have been examined by him since April, 1899, with the result that 301 new double stars have been found. These all have distances between their components of less than 5″.00, 217 or 72 per cent. being closer than 2″.00, and 19 closer than 0″.25. The search has been made mainly with the 12-inch telescope. The zones examined also contain 530 stars previously catalogued as double, but only 308 of these pairs are comparable with the new pairs with respect to the angular separation of their components. A new double star has been found for every 36 stars examined and one star in every 18 examined is double within the adopted limit. On this basis it is estimated that more than 3,000 close double stars, within the reach of the telescopes of the Lick Observatory, still await discovery.

A Kinematic Study of Hansen's Ideal Coordinates: Kurt Laves.

In the 'Auseinandersetzung' of Hansen the ideal coordinates are defined by the equations

$$\begin{aligned} X\frac{d\alpha}{dt} + Y\frac{d\beta}{dt} + Z\frac{d\gamma}{dt} &= 0 \\ X\frac{d\alpha'}{dt} + Y\frac{d\beta'}{dt} + Z\frac{d\gamma'}{dt} &= 0 \\ X\frac{d\alpha''}{dt} + Y\frac{d\beta''}{dt} + Z\frac{d\gamma''}{dt} &= 0 \end{aligned} \qquad (1)$$

$\alpha, \beta, \gamma, \cdots \gamma''$ are functions of the time, the fixed coordinates xyz are connected with the movable coordinates X, Y, Z by means of the equations

$$\begin{aligned} x &= \alpha X + \beta Y + \gamma Z \\ y &= \alpha' X + \beta' y + \gamma' Z \\ z &= \alpha'' X + \beta'' Y + \gamma'' Z. \end{aligned} \qquad (2)$$

Hansen joins to the conditions (1) the condition:

$$Z = 0 \qquad (3)$$

and obtains a well-defined system of ideal coordinates. Hansen has shown that the three homogeneous equations (1) lead to the following theorem: "In every ideal system of coordinates, referred to movable axes, the instantaneous axis of rotation coincides with the radius vector, drawn to the point." It is the intention of this paper to show that the last condition (3) will give rise to a kinematic theorem of similar import. Indeed, when we consider the three vectors, (1) the vector A of absolute acceleration of the point, (2) the vector of $A^{(r)}$ of relative acceleration of the point and (3) the vector $A^{(s)}$ of the acceleration of the movable system, we obtain for their components along the fixed axis three equations, of which only one is written down:

$$\begin{aligned} A_x = A_x^{(r)} + 2\Big(&\frac{dX}{dt}\cdot\frac{d\alpha}{dt} + \frac{dY}{dt}\cdot\frac{d\beta}{dt} \\ &+ \frac{dZ}{dt}\cdot\frac{d\gamma}{dt}\Big) + A_x^{(s)} \end{aligned} \qquad (4)$$

Calling the middle terms on the right sides

$$R_x, \quad R_y, \quad R_z$$

respectively, and projecting them upon the movable axis, we obtain

$$\begin{aligned} R_X &= -\frac{dY}{dt}\cdot r + \frac{dZ}{dt}\cdot q \\ R_Y &= -\frac{dZ}{dt}\cdot p + \frac{dX}{dt}\cdot r \\ R_Z &= -\frac{dX}{dt}\cdot q + \frac{dY}{dt}\cdot p \end{aligned} \qquad (5)$$

p, q, r having their usual meaning

$$R = \sqrt{R_X^2 + R_Y^2 + R_Z^2}$$

will therefore be the moment of

$$\omega = \sqrt{p^2 + q^2 + r^2}$$

with respect to the point, which has for coordinates the quantities

$$\frac{dX}{dt}, \quad \frac{dY}{dt}, \quad \frac{dZ}{dt}.$$

Selecting the position of the XY plane to be that which coincides with the plane of this moment, we have two homogeneous equations of condition, namely,

$$-\frac{dY}{dt}r+\frac{dZ}{dt}\cdot q=0$$
$$-\frac{dZ}{dt}p+\frac{dX}{dt}\cdot r=0 \qquad (6)$$

it can be shown that these are equivalent to the one equation $Z=0$. We derive therefore the following: *Theorem.* The condition $Z=0$, which Hansen imposes upon his ideal coordinates, means that he selects for the XY plane the plane of the moment of the vector of instantaneous rotation with respect to the point of coordinates

$$\frac{dX}{dt}, \frac{dY}{dt}.$$

The Computation of Laplace's Coefficients by Means of Gyldén's γ-coefficients: KURT LAVES.

In this paper it is shown, how the quantities $b^{(i)}$ and $c^{(i)}$ can be determined by means of the definite integrals β^i tabulated by Gyldén in his Hülfstafeln (after multiplication with functions of the argument a). A comparison is made with the table of Runkle, formerly used for this purpose.

Astronomical Photography with the 40-inch Refractor and the Two-foot Reflector of the Yerkes Observatory (Illustrated with lantern slides): G. W. RITCHEY.

The 40-inch refractor, which was designed for visual observations, has been made available for photography through the use of a color screen and isochromatic plates. The greenish-yellow screen, placed in contact with a plate sensitized for light of this color, permits only those rays to pass for which the object glass is corrected. For all but the briefest exposures a double-slide plate-holder is employed. By means of two screws, which move the plate and guiding eye-piece, a star just outside the field being photographed is kept at the intersection of two spider lines throughout the exposure. In this way irregularities in the driving of the telescope, changes in refraction, etc., are corrected. The resulting photographs of the moon, Orion nebula, star clusters, etc., are exceedingly sharp, and are well adapted for measurement on account of their great scale. The two-foot reflector, on account of its short focal length (8 feet) and its freedom from chromatic aberration and absorption, is adapted for a different class of work, in which it admirably supplements the 40-inch refractor. All parts of this reflector were constructed at the Yerkes Observatory. On account of the perfect driving of the clock, permanence of collimation of the large mirror and freedom from flexure in the mounting, photographs of excellent definition are easily obtained. Among those exhibited were the Andromeda nebula, the Orion nebula, nebulæ in the Pleiades, and the expanding nebula surrounding *Nova Persei.*

A Remarkable Disturbance of the Sun's Reversing Layer: GEORGE E. HALE.

A series of photographs of the solar spectrum, taken at the Kenwood Observatory in February, 1894, shows that the reversing layer surrounding a sun-spot was the scene of a great disturbance, which lasted only a few minutes. The diameter of the disturbed area was not less than one-sixth that of the sun. Over this entire region the dark lines of the solar spectrum were for a short time so changed in appearance as to be wholly unrecognizable. Measurements of the photograph show that nearly all of these lines occur in the normal solar spectrum, and that the changed appearance is due to great changes of relative intensity. Thus numerous lines barely visible on Row-

land's map were for a short time very intense, while others, such as the aluminium line of intensity 20 at λ 3,961.674, disappeared entirely. Two sharp bright lines appeared at λ 3,884.67 and λ 3,896.21. These were strongest in the spot, and did not extend to the limits of the disturbed area. Full details will be published in the *Astrophysical Journal.*

The Bruce Spectrograph of the Yerkes Observatory: Edwin B. Frost.

The equipment of the Yerkes Observatory has been recently enlarged by the completion of a spectrograph designed for the special purpose of the determination of the motion of the stars in the line of sight. The addition of this instrument to the accessories of the forty-inch telescope was made possible by the liberal gift of $2,300 from Miss Catharine W. Bruce and $500 from the Rumford Fund of the American Academy of Arts and Sciences. The spectrograph is very rigidly constructed, chiefly of iron and steel, and the prisms are maintained in a fixed, invariable position. The whole instrument is inclosed in a large aluminium case with double walls, for protection against changes of temperature. Coils of wire inside this case can be heated by the 110-volt current of the observatory mains, and it has been found not difficult to keep the temperature of the air in the prism-box within 0°.1 C. during exposures of an hour or more. A correcting lens placed one meter in front of the slit makes the visual forty-inch object-glass efficient for the violet light (λ 4,500) which passes through the prism-train at minimum deviation. The collimator is of 2 in. aperture and 38 in. focus; and two cameras are provided, one of 3 in. aperture and 24 in. focus and another, a Zeiss anastigmat, of about 2.8 in. aperture and 18 in. focus. The first three lenses are of triple construction, designed by Professor C. S. Hastings and made by Brashear. It has proved to be a matter of great difficulty to obtain prisms of the large size necessary to transmit a two-inch beam which are sufficiently homogeneous. (The face of the largest prism is 133 mm. long and 57 mm. high.) After an unsuccessful experience with a set of prisms of what appeared to be excellent glass from Mantois, a quantity of glass was ordered from Schott & Co., of Jena, which should be finely annealed and of the quality of telescope objectives, a requirement which, strangely enough, does not appear to be customary in respect to glass for prisms. This new set of prisms shows considerable improvement over the first ones but the definition is still not the same over the whole surface of the faces. This is now assumed to be due to the moulding of the prisms in trangular shape at Jena instead of melting disks, as we had desired, from which the prisms would be cut by Brashear. Although the spectograph does not fully realize the resolution which the length of the faces of the prisms would imply, the instrument has nevertheless been shown to be capable of furnishing results of a very high degree of accuracy, as illustrated in the paper by an example of a plate of α *Arietis*. The comparison spectra so far employed have been the spark of titanium and of iron and the helium tube. During the exposure on a star the observer guides the telescope by light reflected from the speculum slit jaws, which are not in the same plane, but symmetrically inclined away from the line of collimation, each making with it an angle of 92° 55′. It is also possible, by merely turning a mirror, to observe in the same guiding telescope the light that has gone through the slit and has been reflected at the first surface of the first prism. The method of measuring and reducing the plates briefly described by the writer at the meeting of the Society in 1899 is still in regular use. Plates are measured

both with violet to right and with violet to left under the measuring miscroscope, as an observer may have a large systematic difference in his mode of making a setting on the dark lines of the comparison spectrum and the white lines of the stellar spectrum (on the negative). The writer has a large systematic error of this kind, which is reversed in sign but of the same size when the measures are made on a positive copy of the negative. By measuring the plate in both directions this systematic difference appears to be wholly eliminated. Each plate is reduced by itself, independently of any standard plate of a solar or metallic spectrum, with the aid of the Cornu-Hartmann formula in its simple form, the 'fit' of which can be checked up at the position of each comparison line and the wave-lengths corrected accordingly. The first star found by the Bruce spectrograph to be a spectroscopic binary is η Orionis. Four of the first plates, taken by Mr. W. S. Adams and the writer, yield the following velocities:

1901, Nov.	27,	−68	km. per	second.
Dec.	6,	+13	" "	"
Dec.	18,	+54	" "	"
Dec.	19,	−56	" "	"

The period is not yet determinate. In concluding the paper the proposal was made that the six or seven observatories, which now include in their work the determination of stellar velocities in the line of sight, should cooperate in regularly observing a short list of fundamental velocity stars. The comparison of the results obtained for the same stars with the different spectrographs and different observers, using different sources of comparison spectrum and different lines of the stellar spectra, could hardly fail to be of great value both in indicating causes of error in the separate instruments and in establishing with a high degree of accuracy the velocities of these fundamental stars. (To be published in *The Astrophysical Journal.*)

W. S. EICHELBERGER,
For the Council.

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*THE RELATION OF THE AMERICAN SOCIETY OF NATURALISTS TO OTHER SCIENTIFIC SOCIETIES.**

I AGREE in general with all that has been said, and find myself in especially close accord with the remarks of Professor Trelease—so much so, indeed, that I might well refrain from saying more. Yet there are two points in the discussion to which I should like briefly to call attention.

We are all agreed that the object of our meetings is to spread the method and temper of science among the people—to inoculate the community with the spirit of science. Now, while the great central scientific meetings, so well described by Professor Minot, attract the attention of the whole country for a brief time, they do very little and can do very little in extending the influence or the real temper of science. This must be done, if at all, by the teaching, example and lives of those who are devoted to science, scattered through the country and making their influence felt daily throughout the year. It is, therefore, of the utmost importance that the local centers of science, and especially the smaller centers, remain vigorous. By these small centers I do not mean the great universities, or even the smaller colleges. The life of science in institutions of this character does not need the stimulus of meetings. Even at the present time men thoroughly trained in the methods of science are teaching in the normal schools and in the larger high schools throughout our country and the number of such teachers is rapidly increasing. One most im-

* Part of the discussion before the American Society of Naturalists received after the report had been published in the issue of SCIENCE for February 7.—ED.

portant object of scientific meetings is to furnish to these men, most of whom are working singly in their schools and communities, a stimulus to continue the scientific work for which they have been trained, and an opportunity of bringing the results of their study before a sympathetic audience. This opportunity, however, can be afforded only by a local meeting, and any arrangement of meetings which sacrifices the local gathering to the national meeting will have a disastrous effect on the spread of the scientific temper in the country, because it will necessarily weaken these local scientific centers which, from their number, are quite as important as the more conspicuous and stronger centers of science in our great institutions.

I may perhaps be permitted to call attention to a second matter suggested by the discussion, although it is one in which I am not in any way officially interested. I must own that I look with some concern on the change of the American Association for the Advancement of Science from a general gathering to one composed of professional scientists. It has always seemed to me that a most important part of the work of this Association has been in serving as a common ground of meeting for the professional scientists and those who, without professional knowledge, were interested in science. Its meetings have served as an important means of communication between the professional scientific world and the community, reaching the community in the best of all ways—through those individuals who, though without special knowledge of science, have yet a personal interest in it. This function certainly ought to be performed by some organization and it will be of no small concern to science if the American Association decides to abandon this function.

E. A. Birge.

University of Wisconsin.

ALPHEUS HYATT.

Alpheus Hyatt died suddenly of heart disease at Cambridge, Mass., January 15, 1902, a few months before the completion of his sixty-fourth year.

He was born at Washington, D. C., April 5, 1838; prepared for college at the Maryland Military Academy and passed a single year at Yale College. After a year's travel in Europe, he entered the Lawrence Scientific School at Harvard in 1858, graduating with the degree of Bachelor of Science in 1862.

He enlisted in the volunteer militia in 1862, served for nine months, and at the close of the Civil War was mustered out in 1863, as Captain of the 47th Massachusetts Infantry.

Returning to Cambridge, he resumed his studies under the guidance of Professor Louis Agassiz, the greater part of his time being directed to work upon the fossil Cephalopoda. In 1867 Mr. Hyatt went to Salem, Mass., and was associated with Messrs. Putnam, Packard, and Morse in the care of the natural history collections of the Essex Institute, and of the Peabody Academy of Science, and in the editorial management of the *American Naturalist*. He remained in Salem until 1870, when, on May 4, he was elected custodian of the Boston Society of Natural History. By yearly choice Mr. Hyatt remained the scientific head of the Society until his untimely death.

He held professional chairs in Boston University and in the Massachusetts Institute of Technology, and was at one time or another officially connected with the Museum of Comparative Zoology, and the United States Geological Survey.

Professor Hyatt was a member of the National Academy of Sciences (1875), the American Philosophical Society (1895), the American Academy of Arts and Sciences (1869), and of other leading scientific so-

cieties both in this country and abroad. In 1898 Brown University conferred upon him the degree of Doctor of Laws.

Professor Hyatt's private life, though uneventful, was attended with many blessings; he had vigorous health, congenial work and many friends. He enjoyed scientific meetings and general society; his welcome to his own home, where he was the most charming of hosts, can never be forgotten. His death, though premature, came as he would have wished, in the fulness of his power and without attendant suffering. As a man of true science he was ready, yet loath, to die.

Professor Hyatt possessed traits of character the worth of which cannot be exaggerated; his kindness towards those working with him was very marked, as was also the purity of his thought and speech; his friendship was sincere and hearty, for while he had, as every man has, his moments of excitement, caused by misunderstandings and differences, one could disagree with him on any or on every vital question with full confidence that such clashes would not weaken his regard. Such an entire absence of all personal feeling must be regarded as a very rare and remarkable trait.

From the outline as given, the life work of Alpheus Hyatt may be grouped in three sections: First, as the head of a museum of natural history; secondly, as a teacher of science; and, thirdly, as an investigator. A few salient features of these phases of work may be noted.

For the head of a museum of natural history, Professor Hyatt had many and marked qualifications; his knowledge of zoology, of paleozoology and of geology was extensive; he was skilful in manipulation, suggestive in council, enthusiastic and approachable.

His plan that a natural history museum should be arranged so that a visitor on entering should pass from the simpler groups to those more specialized, and that the specimens in each case should be similarly classified, though opposed as impractical, is both sound and feasible. Somewhat disposed in late years to a too great use of diagrams and models in place of actual material, his recognition of the value of these, of descriptive labels and of a personal guide was early, important, and helpful. His invention of the 'Hyatt bracket' gave an accessory at once simple, effective, and inexpensive, and applicable for greater use than that for which it was planned. It is true that the full realization of much of his best museum work and thought is left for appreciative successors, as Professor Hyatt was too apt to be content with an initiative, the result of which he clearly apprehended, and did not always give attention to the actual carrying out of details, details that in many cases required continuous interest through successive years.

Professor Hyatt's reputation as a teacher will rest largely on the work he did for the Teachers' School of Science. His management of this school was very skilful, and his lectures, of which he gave many courses, were uniformly successful. It was here that he enforced the value of direct observation and comparison, and transmitted the spirit instilled into him by Agassiz to another generation of teachers, many of whom to-day attribute a large share of their success to his methods. His direct influence upon the work of other lecturers in this school may also be mentioned. His early maintenance of a seaside laboratory at Annisquam, Mass., the resources of which were open to teachers so far as space and means would allow, was also an important educational mode.

In the pursuit of his investigations, Professor Hyatt not only studied the accumulations preserved in museums in this country and abroad, but he partook in active field work; he dredged off the east coast at

various points from Labrador to Noank, Conn., and explored many geological horizons in Canada, the Maritime provinces, New England, New York and the far west. His published writings, though less numerous than those of some of his contemporaries, are many and important; they cover a wide field in the Invertebrata, both fossil and recent, and in some cases represent pioneer work in the group studied.

The titles of a few of the more important of his publications may be noted: Observations on Polyzoa (1866–68); On the parallelism between the different stages of life in the individual and those of the entire group of the molluscous order Tetrabranchiata (1867); Fossil cephalopods of the Museum of Comparative Zoology. Embryology (1867); Revision of the North American Porifera (1875–77); The genesis of the Tertiary species of *Planorbis* at Steinheim (1880); Genera of fossil cephalopods (1883–84); Larval theory of the origin of cellular tissue (1884–85); Genesis of the Arietidæ (1889); Bioplastology and the related branches of biologic research (1893); Phylogeny of an acquired characteristic (1894); Cephalopoda (1900).

From the beginning Professor Hyatt's researches were very largely devoted to evolutionary questions, and to the special study of fossil cephalopods; at the time of his death he was one of the foremost authorities upon the fossil Cephalopoda. The true value of his work upon this group must be left for the future; memoirs such as the Genera of fossil cephalopods (1883–84), and the chapter on the Cephalopoda (1900) contributed to the English issue of Zittel's 'Palæontology' cannot be properly estimated by the present generation; they require prolonged and detailed study founded upon large series of specimens. His theory of parallelism based on acceleration and retardation, and his discoveries concerning the laws of development, growth and decline were advocated with persistence and vigor; and while his treatment is not always lucid, he is to be credited as the originator of a distinct school, a school devoted to exact methods of research. The growth of this so-called Hyatt school, never of greater importance than at the time of his death, was a source of sincere gratification to him.

Samuel Henshaw.

SCIENTIFIC BOOKS.

Dictionary of Philosophy and Psychology. Written by many hands and edited by James Mark Baldwin, Ph.D., with the cooperation and assistance of an international board of consulting editors. In three volumes, with illustrations and extensive bibliographies. Vol. I. New York, The Macmillan Company. 1901.

In considering an enterprise of such magnitude as this dictionary offered by Professor Baldwin, the reviewer should keep in mind several important points. He should remember the purpose which guided the editor in his work, its value to those for whom it is especially intended, and the great difficulties of the undertaking. He should not measure it by ideals which the editor never aimed to realize and which it was not necessary for him to realize under the circumstances. Two purposes are combined in the work, Professor Baldwin tells us—'first, that of doing something for the thinking of the time in the way of definition, statement and terminology; and second, that of serving the cause of education in the subjects treated.' The task, therefore, is 'to understand the meanings which our terms have, and to render them by clear definitions; and to interpret the movements of thought through which the meanings thus determined have arisen, with a view to discovering what is really vital in the development of thought and term in one.' The other part of the problem is pedagogical and carries with it the duty 'to state formulated and well-defined results rather than to present discussions.' The reader, therefore, who expects to find nothing but original articles written for experts

and by experts, a work, for example, like Schönberg's 'Handbuch der politischen Oekonomie' or Conrad's 'Handwörterbuch der Staatswissenschaften,' will be disappointed. There are, indeed, 'special' articles on certain topics, and these are of 'encyclopedic character,' but they are in the minority. The Dictionary is meant primarily for the student, not for 'the practised man of research'—a fact which should be kept constantly in view. This will also help to explain the great scope of the enterprise, as set forth in the subtitle: 'including many of the principal conceptions of ethics, logic, æsthetics, philosophy of religion, mental pathology, anthropology, biology, neurology, physiology, economics, political and social philosophy, philology, physical science and education.' The editor justifies himself for attempting to cover such an enormous field with the statement that 'the introduction to a large subject—philosophy, indeed, is the largest subject—must needs include various details of knowledge of other branches of science and information, and of methods, preliminary to its proper task.' The wide inclusion of science receives further justification from the editor's conception of philosophy and of its relation to science. Philosophy is for him 'the attempt to reach statements, in whatever form, about mind and nature, about the universe of things, most widely conceived, which serve to supplement and unify the results of science and criticism.' "It is," he says, "one of the safest sayings of philosophy, at the close of the outgoing century, that whatever we may become to end with, we must be naturalists to begin with—men furnished with the breastplate of natural knowledge. We must know the methods as well as the results of science; we must know the limitations of experiment, the theory of probability, the scientific modes of weighing evidence and treating cases. Lack of these things is the weakness of many a contemporary writer on philosophy. Such a one criticises a science which he does not understand, and fails to see the significance of the inroads science is making into the territory which has so long seemed to be exempt. Note the application of biological principles, in however modified form, to psychological facts; the treatment of moral phenomena by statistical methods; and the gradual retreat of the notion of purpose before the naturalist, with the revised conception of teleology which this makes necessary." The prominent place given to psychology is another necessary consequence of the editor's standpoint, and will receive the approval of all who agree with him as to the fundamental importance of this discipline for science on the one hand, and philosophy on the other. "In biology, in sociology, in anthropology, in ethics, in economics, in law, even in physics," he declares, "the demand is for sound psychology; and the criticism that is making itself felt is psychological criticism. How could it be otherwise when once it is recognized that science is the work of mind, and that the explaining principles by which any science advances beyond the mere cataloguing of facts are abstract conceptions made by processes of thought?" All this is very good, and most modern thinkers will have no difficulty in accepting it. The philosopher cannot ignore science, nor can either he or the scientist do without psychology.

Taking the Dictionary, or rather the first volume of it, as a whole, and judging it by what it sets out to do, we cannot withhold from it our full measure of praise. It is beyond question the best production of its kind in the field, and will doubtless prove a valuable aid to those for whom it was made; indeed, there are few, if any, interested in the general philosophical branches who will not find it a useful vade mecum. Professor Baldwin and his collaborators certainly deserve the gratitude of all students and teachers of philosophy and psychology in the English-speaking world for the arduous task which they have so successfully performed.

And now a word or two with respect to particular points. One of the objects of the Dictionary is to do something in the way of definition and terminology. This is, of course, a highly commendable aim. But there seems to us to be some danger of *over*doing the thing, of attempting to define what cannot be defined, or at any rate cannot be defined satisfactorily within the narrow limits of a sentence

or two. Some of the older American philosophical text-books were in the habit of defining or at least trying to define concepts like consciousness, mind, feeling, etc., and many persons who have used these books still remember the thought-destroying effect produced by their study. Perhaps these experiences have made us too sceptical with regard to certain definitions, but it does not seem that we are helped very much by statements like the following: "Activity (mental). If and in so far as the intrinsic nature of conscious process involves tendency towards a Terminus (q. v.), it is active process, and is said to have activity." "Admiration. Feeling as going out in active approval." "Attention. The mind at work or beginning to work upon its object." "Being. The most general predicate possible and to be affirmed of anything whatever." "Consciousness. The distinctive character of whatever may be called mental life. It is the point of division between mind and not mind." "Determination. The cooperation of all the factors which adequately condition and issue in a mental End-state (q. v.)." "Feeling. Consciousness as experiencing modifications abstracted from (1) the determination of objects, and (2) the determination of action." Perhaps the best thing we can do in many cases is to confess our inability to give satisfactory definitions, as the German professor did, who, when told by one of his students in an examination that he did not know what an animal was, frankly declared that neither did he. So far as the terminology is concerned it is to be hoped that the Dictionary will bring about some uniformity of usage. Its recommendations are, as a rule, very sensible, and there is no reason why they should not be adopted.

With respect to the value of the different articles there will, of course, be difference of opinion. Most of them, however, serve their purpose well. Among those pertaining to philosophy and closely allied subjects the following do not seem to receive the treatment which their importance demands: Analogies of Experience; Association of Ideas; Conscience; Cause Theory (perhaps the article on Parallelism will supply the deficiency); Deism; Dialectic; Dogmatism (Kant's meaning of the term is not clearly brought out); Education; Empirio-criticism; Free Will (and determinism); Innate Ideas (Leibniz's view should be mentioned here); Instruction. The following are among the most helpful and suggestive: Cause; Cause and Effect; Change; Epistemology; Experience; Greek Terminology; Hegel's Terminology; Kant's Terminology (unfortunately this does not include Kant's ethical and æsthetic terminology); Judgment; Latin and Scholastic Terminology. The articles on psychology and æsthetics are generally very good.

The number of subjects discussed in the first volume is quite large, and the Dictionary seems to be very complete in this respect. It would, of course, be impossible to give each possible topic a separate place in the book; many things will have to be considered together under general heads, and the index to the entire work, which is to appear at the end of the second volume, will most likely help the student in his search for certain terms. Perhaps some of the following subjects, which I have tried to find, may turn up in this way: Animal Spirits; Astrology; Corpuscular Theory; Duty (and inclination); Dynamism; Dysteleology (a term coined by Hæckel); Eduction (a term used by some English logicians); Egoism (in the sense of solipsism); Energetik (the term used by Ostwald); Ethelism; Ethical Culture Movement; Euhemerism; Evaluation; Idiopathic (as contrasted with sympathetic, a term frequently used by the Germans—*e. g.*, by Paulsen); Illusionism; Individualism (ethical. Reference might here be made to the article on Anarchism); Intelligible and Empirical Character. There are two articles which might easily be brought under the same head: Ætiology and Etiology. In the article on Determinism we are referred to an article on Free Will Controversies. There is no such article. There ought to be a reference under Empirio-criticism to the article on Introjection, which gives one a much better idea of Avenarius's system than the first article.

The biographical part of the work is, in my opinion, capable of great improvement. Many important names are left out, many unimpor-

tant ones given. Every one cannot be mentioned, of course, but it would be a distinct gain if names like Alanus ab Insulis, Antisthenes, Aristarchus of Samos (he is, it is true, mentioned under the Copernican Theory), Beda Venerabilis, Bolingbroke, Buridan, Calderwood, Cardanus, Digby, Euler, Fiske, Galileo, Gaunilo, Gerbert, Gizycki, Glogau, Guyau, Hamann, Hegesias, Herschel, Wilhelm von Humboldt, Kepler, Laas, Lamennais, Lanfranc, Laplace, to call attention to but a few prominent omissions, could take the place of: Abbadie, Abdalatif, Achenwall, Johann Alanus, some of the Alexanders, Allamand, Arnott, Atwater, Beaseley, the two Hodges and others comparatively unimportant. It is a pity, too, that no biographies are given of living thinkers, say of men like Baumann, Brentano, Dühring, Eucken, Kuno Fischer, Fouillée, Hartmann, Höffding, Jodl, to say nothing of English and American writers of note; but perhaps that would have increased the size of the work beyond all reasonable expectations.

The bibliographies are unequal in value. The psychological bibliographies are usually excellent, including, as they do, the best monographs in the field. The literature on æsthetics is also good. The philosophical, logical, ethical, epistemological and educational lists of references, cannot as a rule compare with the others; some of them are quite meager, often ignoring the best recent literature. It is one of the most valuable functions of a work like the Dictionary to guide the student in his reading and to put him in touch with the best work done everywhere. It would be an advantage if the third volume of the Dictionary could give not only the *names* of books, but critical comments on some of them.

In conclusion I should like to call attention to a few minor details. There should be some uniformity (1) in German spelling, (2) in the use of the English possessive, and (3) in French titles. Sometimes the old style of German spelling is used, sometimes the new. We get *Urteil* and *Urtheil, Funktion* and *Function, Defekt* and *Defect, Produkt* and *Product,* etc., etc. Sometimes the Dictionary uses the apostrophe followed by *s* in English possessives ending in *s,* sometimes it uses the apostrophe only. Thus we find St. Vitus's, Cornelius's, James's, St. Thomas's, Leibnitz's, and Descartes', Averroës', Leibnitz', and so on. In the French titles capitals are sometimes used and sometimes not. There are a few other cases in which we get differences in spelling. The Dictionary writes Kratylus and Kritias, but Crates, Carneades, Cleanthes. Quesnai and Quesnay occur, Frankfurt and Frankfort, Clement and Clemens, Renaissance and Renascence, spatial and spacial, and if I am not mistaken Occam and Okham.

The terms adoptionism and *Adoptionismus* are used instead of adoptianism and *Adoptianismus,* which are the more common forms. Clanberg should be Clauberg. Instead of *Agent* the Germans use the term *Agens* in the sense employed on page 25. The usual German equivalent for common sense in the meaning given on page 200 is *gesunder* or *gemeiner Menschenverstand. Askese* is more common than *Asceticismus.* The counter-reformation is *Gegen-reformation* in German. On page 92 Höffding is referred to as an authority on mediæval philosophy. Schmidt's 'Ethik der alten Griechen' is spoken of as a history of ethics on page 344; it is a history of Greek morality and ideals rather than of Greek systems. The title of Ziegler's book is: 'Die Ethik der Griechen und Römer.' On page 67 the term patristic fathers is used. On page 500 a passage from Munro's translation of Lucretius is given without credit. On page 5 a translator's name is given as Filkin, on page 189 as Falkin, on page 557 as Felkin. Homo-ousios (p. 67) should be homoi-ousios. On page 596, first column, eighth line from the bottom, the word *to* should be placed between *that* and *phenomena.*

Typographical errors are: *Nature* for *Natur* (p. 5); 1794 for 794 (18); peritheral for peripheral (28); Gaston for Galton (46); base for bare (61); Bohme for Böhme (124); idiomotor for ideo-motor (217); Adeckes for Adickes (246); Elsenhaus for Elsenhans (216); Seipsis for Scepsis (320); *Raumvorstellungen* for *Raumvorstellung* (364); 21 for 214 (521); Frauenstadt for Frauenstädt (537); instinct for institut (579); Mansell for Man-

sel (347); Micklejohn for Meiklejohn (285); Laud for Land (21); and a few others even more insignificant than the above.

Volume II. will contain the remainder of the text, from Le to Z, Addenda, full indices of Greek, Latin, German, French, and Italian terms, while volume III. will be devoted exclusively to the general bibliographies.

The Macmillan Company deserve great credit for making such a publication possible and for the manner in which they have performed their part of the work.

Frank Thilly.

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Report on a Botanical Survey of the Dismal Swamp Region. By Thomas H. Kearney. Contributions from the U. S. National Herbarium, VI.: 6. Washington, 1901. 8vo. Pp. 263, 12 plates, 39 figures and 2 maps.

The account of the Dismal Swamp vegetation here presented is both a valuable and a thoroughly readable one. The subject is handled from a number of viewpoints in such a way that the reader obtains a well-rounded conception of this particular vegetative covering and of the interrelations of its constituents. The author is especially to be commended for his careful inquiry into the causes which produce the characteristic modifications of the various vegetation forms, and for the histological investigation of certain species, a study which is altogether too rare as yet in ecological research.

Under 'Climate' the author discusses the usual physical factors, temperature, sunshine, humidity, precipitation and wind, though the data unfortunately could not be secured for the Swamp itself, but only for the neighboring meteorological stations, Norfolk and Cape Henry. The prominent physiographic features of the region, to which correspond, of course, certain plant formations, are (1) the beach and the dunes, (2) the salt marsh, (3) the plain and (4) the swamps. A very important discussion of the soils of these areas is contributed to this portion by Mr. F. D. Gardner, of the Division of Soils.

In the treatment of the vegetative covering of the region, the author recognizes a maritime and an inland group of formations. The former comprises the saltmarsh formation and the sand-strand formations. Under the first are arranged a number of associations, *Spartina stricta* association, *Typha* association, *Juncus* association, which are, in fact, alternating areas of the formation, in which a certain facies or principal species is controlling. Little attention is given to the relative importance of the species constituting the formation, or to their sequence in time. The most important physical conditions which cause modification in saltmarsh plants are partial submersion at high tide, a soft yielding substratum and an excess of sodium chloride in soil and water. The resulting modifications are largely concerned with the reduction of the water loss, as is typical of halophytes, by thickening the cuticle and the epidermal walls, by the development of a dense hairy covering, the sinking of the stomata, the conduplication of the leaf, or its partial or complete reduction, the development of succulency, the presence of a considerable quantity of salts in the cell sap, and the development of palisade tissue. The value of the sheathing bases of the old leaves in preventing the access of salt water must be regarded as somewhat doubtful. The consideration of the sand-strand vegetation is clear and interesting. The beach and outer dunes are characterized chiefly by *Ammophila arenaria, Uniola paniculata, Iva imbricata, Panicum amarum minus, Cakile edentula* and *Salsola kali.* The vegetation of the middle dunes is much less open in nature. The most characteristic feature is, perhaps, the dense, often pure, thickets of *Myrica carolinensis.* Other thickets are constituted by *Prunus angustifolia, P. serotina, Salix fluviatilis* and *Cephalanthus occidentalis.* The inner dunes are wooded for the most part with *Pinus tæda,* but a number of deciduous trees and shrubs, *Quercus, Diospyrus, Sassafras* and *Juniperus,* occur here also. An excellent analysis of the effect of the mechanical action of the wind, and of the effect of excessive transpiration follows the floristic discussion.

The non-hygrophile inland formations are (1) forest formations, embracing the mixed forest and the pine barrens, (2) cleared-land formations, non-cultural and cultural, (3)

fresh-water formations, comprising the hygrophile forest, with its two types, the black gum swamp and the juniper swamp, and the fresh-water marsh formation, with the reed marsh and the low-marsh types. The phytogeographical affinities of the flora are discussed at some length, touching upon the position of the species in the various vegetation zones. The northern limit of Dismal Swamp species is tabulated in an exhaustive manner. The broader relationship of the flora receives some attention also, a number of interesting comparisons being made. The agricultural products of the region are touched upon briefly, special consideration being given to the influence of drainage and soil composition upon the native and cultural vegetation.

Anatomical notes upon the leaf structure of a number of the most interesting species ecologically constitute a very important feature of the work. The notes treat chiefly of the adapted structures of the leaf, embracing a brief description of the leaf, the epidermis, mesophyll, mestome and stereome. Much is to be said in commendation of thorough histological work of this sort, a field of investigation which must come to play an increasingly important part in all comprehensive ecological work. The text closes with a list of the plants of the region, a bibliography of the books and papers consulted, and a full index.

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Monographie der Termiten Afrikas. By Yngve Sjöstedt. Köngl. Svenska Vetenskaps-Akademiens Handlingar, Vol. xxxiv., No. 4, 1900 (received late in 1901). Pp. 236. Plates IX.

Africa, the classic land of Termites, has, in recent years had its termitid fauna quite thoroughly explored. New species have been coming thick and fast from the pens of Sjöstedt, Wasmann, and Haviland; and now the work is capped by an excellent monograph from the hands of the Swedish student.

The author has had at his disposal practically all of the available material, and with great care has produced a work that will always be the basis for the future study of African white ants. Descriptions are given of 82 species, arranged in six genera; and tables are given for the determination of the species. One of the notable features of the work is the attention paid to biology. The habits of each species, when known, are detailed at considerable length, and four of the plates represent nests or parts of them. We are accustomed to think of Termite nests as being pyramidal in shape, but this applies only to certain species of *Termes;* the nests of *Eutermes aurivilli* and *E. fungifaber,* which are illustrated, are larger at the top than at the base, and have the appearance of some gigantic mushroom. The tree-nests of *E. arborum* and *E. arboricola* are also figured, the former attached to the twigs, the latter to the trunk of a tree. Accounts are given of how the natives collect certain species for eating, and of how other species collect grass and leaves, and conduct their mushroom gardens. Two bibliographies are appended: One, a list of papers on African termites; the other, a list of termitid literature published since Hagen's 'Monograph of the Termites' in 1855.

NATHAN BANKS.

SCIENTIFIC JOURNALS AND ARTICLES.

THE January number of the *Botanical Gazette* (the first of Volume XXXIII.) opens with an article on 'Binucleate Cells in Certain Hymenomycetes,' by R. A. Harper, of the University of Wisconsin. Dr. Harper confirms and extends the results of Maire, finding the young cells of numerous Hymenomycetes to be binucleate. On the basis of these and other observations he then discusses the relationship of the Basidiomycetes with the Ascomycetes, controverting the conclusions of Massee, and holding that "the widespread occurrence of regularly binucleated cells in the Basidiomycetes, with the additional evidence that these cells reproduce by conjugate division and constitute the reproductive series in each individual through at least a considerable part of its life-history, leading up to the formation of basidia, while no such binucleated cells are found in Ascomycetes, in either vegetative or ascogenous hyphæ, shows that the two groups are widely separated phylogenetically. * * *

On the other hand, it is quite clear that the binucleated condition in the hyphæ of both groups still further strengthens the evidence for the relationship between the rusts and Basidiomycetes."

Judson F. Clark, of Cornell University, discusses the 'Toxic properties of some copper compounds, with special reference to Bordeaux mixture.' Clark shows that solution of such of the Cu $(OH)_2$ in Bordeaux mixture as is of fungicidal value, is chiefly accomplished by the solvent action of the fungus spores themselves, the total amount of copper necessary being probably not more than one part in 80,000. The amount of injury done to the host, which also has the power of absorbing the copper hydroxid deposited on its leaves, depends on the specific susceptibility of the protoplasm, the solvent properties of the cell sap, the permeability of the epidermis, and the weather conditions following spraying.

G. P. Clinton, of the University of Illinois, announces the discovery of *Cladochytrium Alismatis* Büsg. on *Alisma Plantago,* near Cambridge, Massachusetts. This is the first time this fungus has been found in America. He describes also a peculiar temporary sporangial stage which it had not been previously known to possess. He was also successful in germinating the resting sporangia, which had not been accomplished before.

J. C. Arthur, of Purdue University, discusses briefly 'Clues to Relationships among heteræcious Plant Rusts,' and Leslie N. Goodding describes six new species of plants from the Rocky mountain region.

Fifteen pages of reviews of current literature and four pages of news complete the number.

The December number of the *American Geologist* contains a portrait and a short biographical sketch of the late Ralph D. Lacoe of Pittsburg, Pa., by the Rev. H. F. Hayden. Also the scientific work of the late W. H. Barris of Davenport, Iowa, is described briefly by C. H. Preston and the article accompanied by a portrait. Neither of these men were professional scientists but their contributions to paleontology are valuable and lasting. 'The Loess of Iowa City and Vicinity' is discussed by B. Shimek. He describes the fossils found in the loess and compares them with the forms now living in the vicinity and other loess deposits. E. R. Cummings discusses 'A Section of the Upper Ordivician at Vevay, Indiana,' accompanying the article with two plates of fossils. 'The Cleveland Water Supply Tunnel,' by S. J. Pierce. From the evidence furnished by this tunnel and other work done in the vicinity the author describes a deep V-shaped preglacial valley emptying into Lake Erie, about nine miles long and at its greatest depth 450 feet below the lake level.

The Journal of Physical Chemistry. November. 'Equilibrium between Carbonates and Bicarbonates in Aqueous Solution,' by Frank J. Cameron and Lyman J. Briggs; 'Solubility of Gypsum in Aqueous Solutions by Sodium Chlorid,' by Frank K. Cameron. These papers are communications from the Bureau of Soils of the United States Department of Agriculture. 'Mathematical Expression of the Periodic Law,' by S. H. Harris; 'The Optical Rotatory Power of Cane Sugar when Dissolved in Pyridin,' by Guy Maurice Wilcox.

December. 'Oxidation of Ferrous Solutions by Free Oxygen,' by J. W. McBain. It is found that the oxidation of ferrous solutions by free oxygen is unexpectedly slow and that it increases with the concentration of the ferrous salt. 'Some Applications to Chemistry of J. J. Thomson's Work on the Structure of the Atom,' by Felix Lengfeld; 'Solubility of Gypsum in Aqueous Solutions of Certain Electrolytes,' by Frank K. Cameron and Atherton Seidell. A further study from the Bureau of Soils. In dilute solutions the solubility curves follow the direction indicated by the application of the mass law to the hypothesis of electrolytic dissociation. For high concentrations this is not generally the case, but in such solutions ionic complexes seem to be formed.

SOCIETIES AND ACADEMIES.

THE NORTHEASTERN SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The regular monthly meeting of the Section

was held in the rooms of the German Turnverein on Tuesday evening, January 28. Dr. James Locke, of Yale University, addressed the Society on 'Some Recent Problems in the Systematization of Inorganic Compounds.' The paper was a résumé of some work on the solubility of various alums, and of certain double sulphates, which has been in progress for several years in the laboratories of the Sheffield Scientific School. It was shown that when the solubility of the alums of aluminium, vanadium, chromium, and iron with ammonium, sodium, potassium, cæsium, rubidium, and thallium is expressed in gram-molecules per liter of water as a function of the atomic weight of the trivalent metal, a figure is obtained in which the straight lines connecting the solubility of any two trivalent metals with successive univalent metals meet in a point, if prolonged. It was assumed that the points of solubility stand in fixed mathematical ratio to one another, and it was shown that if the difference of the solubility of the alums of a trivalent metal with two alkali metals is called the increment of solubility of the latter, then the ratio between the increments of solubility of the corresponding alums of two trivalent metals for any two alkali metals is a constant. This general law was amply confirmed by the experimental results, and it was shown that the solubility of new alums could be predicted with considerable accuracy.

Dr. B. S. Merigold, of the Worcester Polytechnic Institute, read a paper on 'Some Recent Work on Uranium,' in which he described the method and apparatus for obtaining pure anhydrous uranous bromide and the use of this substance for the determination of the atomic weight of uranium. The mean value of two sets of experiments was 238.52, about one unit lower than the recent values of Zimmerman.

HENRY FAY,
Secretary.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY OF THE NEW YORK ACADEMY OF SCIENCES.

A MEETING was held on January 27. The chairman, Professor Farrand, after opening the meeting, called on General James Grant Wilson to preside.

Mr. F. S. Dellenbaugh explained his understanding of the location of the historic towns and 'nations' of the Rio Grande valley in New Mexico prior to 1630. This differs radically and entirely from the present accepted arrangement. He maintains that the location of Tiguex, rather than Cibola, is the key to the correct solution of this problem, and from strong evidence derived from Benavides, Espejo, Castañeda and others, he locates Tiguex near San Antonio station. The site at Bernalillo, for this central town, so long advocated by Bandelier and his followers, he declares is impossible. With Tiguex at San Antonio station, the famous 'Seven Cities of Cibola,' which Bandelier placed on the site of modern Zuñi, are thrown instead into southwestern New Mexico, either on the Gila near Old Camp Vincent, or Old Fort West, or between these and the Florida Mountains, with the balance in favor of a site on the Gila. Cicuyé, instead of being at Pecos, was apparently a Tompiras town, either what has been erroneously called *Gran Quivira* or some village of that locality. The Braba of Coronado would fall in the vicinity of the present Cochiti, instead of at Taos, and Tusayan instead of being at the Moki Towns, would fall in its position 20 leagues (50 or 60 miles) northwest of the position of Cibola.

Mr. Harlan I. Smith presented a paper on the 'Hauptman Earthwork,' in Ogemaw County, Michigan. The discovery of this earthwork was first announced by him in SCIENCE, June 21, 1901 (p. 991). Personal observation in July enabled him to correct its location somewhat. It is on Section 33 or 34, or both, T. 22, N. (instead of 21), R. 1, E. It was found to lie in a lumbered pine area, and, unlike most such earthworks, far from any watercourse. It is covered by dense undergrowth and fallen timber. It is composed of a rounded embankment of earth, about 2 feet high and 12 feet wide, encircling an area about 197 by 177 feet; outside this is a ditch, 2 feet deep, 6 feet wide at the top, but narrowing towards the bottom. Signs of another embankment were seen outside the ditch, and within the enclosed area were several humhocks which may prove to be mounds or sim-

ilar works. There are three openings in the embankment. The antiquity of the work is indicated by the presence of large pine stumps on the embankment and in the ditch; the largest stump measured 13 feet 4 inches in circumference.

An effort is being made to have this ancient work enclosed in a state, county or township park. The land, now worth perhaps less than $10 an acre, can easily be secured. If neglected, the road to be built on the line between sections 33 and 34 will probably destroy the work.

Dr. John R. Swanton reported some results of his investigations into the mythology and origin of the Haida Indians of northern British Columbia. The whole Haida people is divided into two clans, Raven and Eagle, each of which is strictly exogamic with descent in the female line, and has its own crests, its own names, its independent traditional centers of origin. Each is subdivided into a number of families. The Raven clan traces its origin from a single legendary ancestress, who is reputed to have emerged from the waters with the Haida island. Some families of that clan, however, trace their descent from other sources. The Eagle clan has much less traditional unity of origin, and there are certain indications in the tradition that this clan is of foreign origin or at least has received considerable admixture of foreign blood. One important fact that seems to point to the Raven clan as the indigenous element is the great preponderance of Ravens among the supernatural beings of the island.

R. S. Woodworth,
Secretary.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

The Section of Astronomy, Physics and Chemistry met at the Chemists' Club on February 3. Mr. G. B. Pegram addressed the Section on the subject of 'Experimental Methods of Studying Radio-Activity.' Mr. Pegram described the principal methods which have been used in the study of radio-active substances and also gave a brief summary of the more important results so far obtained. The address was followed by a very interesting discussion of the subject.

F. L. Tufts,
Secretary.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO.

At the meeting of October 23, 1901, the following paper was presented:

'The Origin and Development of the Wings of Coleoptera': W. L. Tower.

The embryonic origin of the wings was studied in *Lepitinotarsa decemlineata,* where the hind wings were found to be derived from the rudiment of the metathoracic spiracle. The elytra are also probably derived from the remains of the mesothoracic spiracular disk, which are left in the segment after the anterior migration of the spiracle of the mesothorax.

In the larvæ of several species of beetles the wings were found to develop in one of three ways: (1) Directly beneath the cuticula—Carabidæ, Cerambycidæ, Buprestidæ and others; (2) in a shallow peripodal sac, which is broadly open against the cuticula—Scarabæidæ; (3) in a closed peripodal sac which is removed to a greater or less distance from the surface—Coccinellidæ, Chrysomelidæ.

In the wings there is a larval temporary tracheal system which develops from the cells of the hypotrichal membrane of the tracheal trunks. This system is functional in the late larva, prepupa and early pupa, but is destroyed during the pupal stage, probably by ferments in the hæmolymph and not by phagocytes.

The elytra and hind wings were found to have an essentially similar structure, both gross and microscopic, and are therefore homodynamous organs. The development of scales and glands, the development and finer structure of the cuticula, and the behavior of the hypoderm were followed in detail, and have given interesting results.

The conclusion reached is that the wings of beetles are homologous to those of other insects, but are specialized by reduction. They are not divergent organs specialized for a new function, as was stated by Krüger.

MEETING OF NOVEMBER 6, 1901.

'Spermatid Transformations in *Gryllus*

assimilis with Special Reference to the Nebenkern: W. J. BAUMGARTNER.

After the anaphase of the second spermatocyte division, the chromosomes separate and break up as has been described in other forms. But as the nucleus elongates to form the head of the spermatozoon, it forms a tube instead of a solid mass as described for other forms. The head has a darkly-staining outer wall of chromatin, and a hollow clear space probably filled with nuclear sap.

The remaining fibers, after they are cut by the division-plane, become fewer and thicker; their ends bend together and they form a 'striated' nebenkern, a condition not previously described. This striated nebenkern looks like an egg with dark drawn-out ends, and several (frequently five) dark cross striæ parallel with the long axis of the cell.

In a relatively short time the fibers break up, and soon the dark-staining substance appears as a round ball, which, with the immediately surrounding clear space, is enclosed by a surrounding membrane. In cross-section this appears as a dark circle, a ring of clear space and another dark ring.

As the axial filament grows out it passes over the surface of the bounding membrane, and not through the nebenkern. Soon after this the nebenkern elongates, loses the ring, and the dark ball passes back (away from the nucleus) along the tail, sometimes breaking up into several small drops. The substance is thus distributed over the tail and forms a covering for it.

A second body in the cytoplasm is smaller and always lies in the angle between the nucleus and the nebenkern. As the nebenkern passes backward and disappears, it moves up against the nuclear membrane, passes to the front end of the elongating head and forms the point. Its origin could not be determined, but from its destiny it corresponds to an acrosome.

C. M. CHILD,
Secretary.

THE TEXAS ACADEMY OF SCIENCE.

THE formal midwinter meeting of the Texas Academy of Science was held in the rooms of the Business Men's Club, at Waco, on Thursday evening, December 26, and Friday morning, December 27, 1901.

The speaker at the evening session was Dr. Frederic W. Simonds, Professor of Geology in the State University. He was introduced by the president, Professor J. C. Nagle, of the Agricultural and Mechanical College of Texas.

The subject as announced was 'Petroleum.' The speaker opened with a brief statement concerning the oil development in the State of Texas—a comparison having been made with the fields in the North and in California. He then entered upon a discussion of the nature of petroleum, showing its position in the hydro-carbon compounds and commented at some length upon its physical properties. The theories of the origin of petroleum received special attention, references having been made to the early work of the late Dr. T. Sterry Hunt and the more recent work of the late Professor Orton as well as to the investigations of many other distinguished students. The evolution of the oil well from that which was hand drilled to the modern steam drilled well was discussed and the latest statistics of the oil industry both in the United States and in Texas announced. With the generous assistance of Dr. A. F. Sontagg thirty excellent illustrations of the present condition of the oil development in Texas, including several Beaumont gushers, were thrown upon the screen.

At the morning session the following papers were presented: 'The Petroleum of Jefferson County, Texas,' by Professor H. H. Harrington, of the Agricultural and Mechanical College of Texas. Of this oil he says: "It makes an excellent fuel oil; but this is not to my mind its most promising feature. The sulphur which it contains (about 2 per cent.) is larger than that found in any other known petroleum; and is a menace to it as a source of illuminating oil or kerosene. Unlike most other oils in the United States, it has asphalt for a base * * *. This, it seems to me, is the key to its usefulness. Distilled it furnishes a good quantity of kerosene fraction, but with a high boiling-point and leaves a residue of fine asphalt, not excelled perhaps by that of

Trinidad. A protective tariff on asphalt is all that is needed to increase the value of the Beamont residue.

* * * * *

The following is a detailed analysis of the oil: Sp. Gr.=.912—very heavy. Begins to distill at 70°C. and boil at 150°C.:

70°—150°C.—	3.337%	comes	over.	
150°—260°C.—	41.00	"	"	"
260°—300°C.—	19.00	"	"	"
300°—350°C.—	20.00	"	"	"
Above 350°C.—	16.67	"	"	"

"The first distillate below 150°C. is what is ordinarily known as the 'Benzine Fraction,' and as noted is 3.33% of the crude oil; it boils at 70°C. 150° to 260°C. is the illuminating oil fraction; 260° to 300°C. are the light lubricating oils; and 300° to 350°C., heavy lubricating oils, mixed with asphalt. The remaining 16½% is asphalt. As before mentioned, the amount of sulphur in the oil is the greatest obstacle in the way of refining it. When the illuminating fraction is refined, it requires the use of a much larger percentage of sulphuric acid, and the loss on refining from treatment with this acid is much greater * * than takes place with oils having a paraffine base and very little sulphur."

Professor Frederick W. Malley, of the Agricultural and Mechanical College, presented a paper on 'Factors of Progress in Insect Warfare,' in which he indicated the lines of effort and research among economic entomologists at the present time and made a comparison with similar work attempted twenty years ago. He grouped the warfare roughly into four great divisions: Insecticides, Cultural Methods, Parasites and Natural Enemies, and Climatic Conditions. The whole discussion was from the standpoint of *applied* entomology and a plea was made for elementary instruction along these lines in the public schools of the State.

Professor D. W. Spence, of the Agricultural and Mechanical College, discussed the 'Effects of Prolonged Exposure to X-rays on the Human Body,' showing their extraordinary effects, in some instances, in producing a disintegration and diseased condition of the skin. He himself had his hand in bandages covering a 'burn' of some months duration and not yet healed.

'A Preliminary Report on the Austin Chalk Underlying Waco and the Adjacent Territory' is the title of a paper presented by Mr. J. K. Prather. The rocks of this formation within the area mentioned were described minutely and their position in the great Upper Cretaceous Series, pointed out. Reference was made to the early work of Dr. Ferdinand v. Roemer and a list of fifteen characteristic fossils given. Examples were also given of the vertebrate remains found in this formation and attention called to the fruitfulness of this field for investigation in that direction.

Professor T. U. Taylor, of the Engineering Department of the University of Texas, gave an account of the 'Big Springs of the Edwards Plateau'—the region bounded by the Colorado River, the International and Great Northern and the Southern Pacific railroads—showing their fluctuation in discharge and offering an explanation therefor.

Mr. John K. Strecker, Jr., made a 'Preliminary Report on Reptiles and Batrachians of McLennan County.' In this paper are recorded many interesting and valuable observations extending over a period of years concerning the life and habits of these little-known species of animals.

The closing paper, on 'Dr. Ferdinand von Roemer, Father of the Geology of Texas: His Life and Work,' was presented by Dr. F. W. Simonds of the State University. Dr. Roemer was born at Hildesheim, Hanover, in 1818, and died in Breslau in 1891. In 1845 he visited Texas and wrote the first account of the physical geography and geology of the State. His monograph upon the Cretaceous of Texas—'Die Kreidebildungen von Texas'—appeared just fifty years ago.

Frederic W. Simonds,
Secretary.

University of Texas.

The Elisha Mitchell Scientific Society.

The 139th meeting of the Society was held on February 11, at the University of North Carolina. The following papers were read:

'The Pressure of Light': J. E. Latta.

'A Nineteenth Century Geometry': ARCHIBALD HENDERSON.

'The Absolute Properties of Molecules': J. E. MILLS.

CHAS. BASKERVILLE,
Secretary.

DISCUSSION AND CORRESPONDENCE.

A GEOGRAPHICAL SOCIETY OF NORTH AMERICA.

IF a general American Geographical Society, equivalent in rank to the Geological Society of America, could be developed by following Professor Russell's plan (SCIENCE, Jan. 31), there is no question that great good would come from it; but I do not believe that his plan would lead to the desired end. After stating some of its difficulties, I will present an alternative.

Centralization that weakens local activity is of doubtful value. It is perfectly true that the publications of the existing geographical societies are not always of a high order, but they are the best that the local societies can produce; they serve a very useful purpose in providing opportunity for beginners to publish their early efforts; they are the necessary steps toward something better. Furthermore, several of the local journals, being largely concerned with personal narratives of outings and excursions, are of greater interest to their local readers than any general and scientific geographical journal could be. It would more likely kill than kindle geographical interest to replace such local journals by a high-grade scientific central journal. The sufficient reason for this is that the great majority of the local readers are not geographers. This leads to the next difficulty.

No equivalent of the Geological Society of America could be made by uniting the existing geographical societies of the country. Candidates for membership in the Geological Society are carefully scrutinized. They must have had good scientific training and they must have actually accomplished something in the way of geological work, either in the field or in the lecture room, before they are recommended by the Council of the Society for election. The standard of training and accomplishment is not by any means discouragingly high, but it is set at such a level that membership in the Society really means something regarding a member's geological attainments. There is not a single geographical society in the country in which there is any corresponding requirement for membership. Any reputable person who is willing to pay the necessary fee may be elected. The societies are all glad to add his name to the count of members, and his fee to the treasury. In some of the societies it may perhaps be assumed that a considerable number of members feel a certain interest in the general subject of geography, an interest that is passive rather than active; but in nearly all the societies there is a large number of members whose interest is excited chiefly by the meetings, outings and excursions that the societies promote. Even in this respect, only one society, the Mazamas, exacts any performance as a measure of interest, and the performance that it demands—the ascent of a mountain some thousands of feet in height—is no more a test of geographical training and accomplishment than is the test that might be exacted by a yachting or a hunting club. By all means let the meetings, outings, excursions and mountain ascents continue; let the societies that conduct them flourish; let the publication committees secure the best narratives that the members can produce; but do not let us imagine that the members of these societies are all geographers.

Turning now to constructive suggestions: Let the proposed society be satisfied with the northern part of the New World for its field; let its name be the Geographical Society of North America, in order not to imply that America is all north of the Isthmus, and not to infringe upon the name already occupied by the society long established in New York city. Let the various geographical societies of North America be invited to send delegates, one for every five hundred members, to Pittsburgh next summer at the time of the meeting of the American Association; and let these delegates invite fifty or a hundred persons of real geographical attainments to become 'original members' of the new society. Let those who accept this invitation meet at Washington in Convocation Week, 1903, and

proceed with the more formal organization of the society. Let them at the beginning imitate the Geological Society of America and other societies of similar grade by requiring that all approved candidates for membership shall be well-trained and productive students of geography, or of some phase of that broad subject. Let the membership fee be set at such a figure that the society may be self-supporting, able to conduct its own publications. Let essays for publication be carefully scrutinized by the council, and let it be recognized that a merely personal narrative of travel no more constitutes a geographical essay because it mentions a harbor or a hill than it constitutes a botanical essay because it mentions a swamp or a forest. Let it be understood that all communications must present an objective account of some element of inorganic environment, or of some organisms in their environment, or an account of the relationship of the two. Let such treatment of the subject be required as shall indicate that the contributor has had sound training in preparation for his work of observation, description, generalization, inference and so on; let the work of apprentices and amateurs be referred to local societies for further development before acceptance in the general society. In a word, let the beginning be marked by careful attention to quality rather than to quantity. Let growth be sound even if slow. Let membership be accessible not to the mere traveller, the lover of outdoor nature or the reader, but only to the investigator, whether he stays at home or roams abroad. Let a standard be set that will demand training and accomplishment on the part of those who reach it, in contrast to the dilettanteism that suffices for membership in all the present geographical societies.

The manifest difficulty in the way of establishing and maintaining such a society is the great diversity of interests among those who should be considered as trained geographers. The subject is a natural unit for schools in its elementary reaches; but the paths of its maturer scholars are divergent. The geodesist, the meteorologist, the hydrographer, the geomorphologist, the ethnologist, the economist, might perhaps repel rather than attract one another, so unlike are their lines of thought and their methods of work. Their association with other sciences might be stronger than with geography; the geodesist with astronomy, the meteorologist with physics, the hydrographer with engineering, the geomorphologist with geology, the ethnologist and the economist with ethnology and economics. But diversity of specialization characterizes all learned societies. In the Geological Society, the paleontologist does not always listen attentively to the glacialist, nor the petrographer to the physiographer, and all these sometimes fail to follow the local stratigrapher. Diversity of interest does not, therefore, prohibit the effective union of experts; and such a union along geographical lines would be well worth trying. I hope that others who may be interested in any aspect of this scheme will send a statement of their opinions either to Science or to Professor Russell direct. If a considerable measure of interest is thus indicated, let us beg Professor Russell to proceed in the direction indicated by the majority of his correspondents and take the necessary steps for a preliminary meeting at Pittsburgh, so that an effective organization may be made at Washington a year hence.

W. M. Davis.

Harvard University,
Feb. 6, 1902.

THE RISE OF ALKALI SALTS TO THE SOIL SURFACE.

The explanation given by Means (Science, of January 3) of the accumulation of soluble salts on the surface of soils by the differential action of capillary and gravitational pores, seems also to offer a correct explanation of the length of time and large amount of water required for an effectual leaching-out of alkali salts by flooding. The fact shown in the investigations of the California Station, that in coarsely sandy lands the maximum of the salts is found not *at*, but at some distance *below*, the surface, offers a correlative corroboration.

But this explanation certainly does not apply to the case referred to by Means, viz.,

the Fresno region, where the ground water originally stood forty feet below the surface, while now it is at a few feet, and sometimes *at* and above the soil surface. It is historically certain that the rise of the ground water came about there, as at many other points, not from direct over-irrigation, but by the enormous leakage of water from ditches with porous, sandy bottoms and banks. From these I have frequently traced the water slope sideways until the auger reached a depth of ten or more feet; and the gradual rise of the water level in neighboring wells, whose sides remained dry save within reach of the capillary rise of the water, proved plainly that the water was ascending from the original level by hydrostatic adjustment, not by penetration from above; where as a matter of fact irrigation often had not even begun.

The extraordinary accumulation of alkali salts at the surface that has occurred in the Fresno and some other regions of the San Joaquin valley, are clearly due originally to the leaching upward of the entire mass of alkali in the sub-strata. The investigations of the California Station have shown that in the arid region few uplands normally contain less than from 2,000 to 2,500 pounds of soluble salts per acre in four feet depth; and much more has been found in the silty sub-strata of the Salton basin in southern California, even to 22 feet depth. When all the salts thus contained in 40 feet of material are leached to the surface in addition to the accumulation already existing there, the overwhelming invasion we find where these leaky ditches exist cannot surprise us. E. W. HILGARD.

REPRINTS OF SCIENTIFIC PAPERS.

TO THE EDITOR OF SCIENCE: Will you allow me space for a word concerning a point of professional courtesy? It arose in connection with a personal experience. The incident is wholly trivial, namely, the failure of the publishers, or editor, of the *New York Teachers' Monographs* to furnish the reprints promised of an article which appeared in the October number.

It is the custom of writers on technical science to exchange copies of their published monographs. The brochure is sent frequently with an explicit—and always with at least the implied—request for a similar courtesy in return, upon the appearance of anything of the receiver's own in print. The relation thus becomes one of simple duty, which may not be considered or disregarded at will. To each of his correspondents one owes a debt which is discharged only when copies of his own published work have been sent in exchange.

But the matter goes deeper. The contributor to technical scientific periodicals is rarely, if ever, paid for his writings. These publications, in many instances founded and supported by associations of scientific students, are not primarily commercial enterprises, but vehicles of communication among scholars having common interests and aims. They are means by which is made possible the publication of monographic literature, the printing of which, in the majority of cases, would be too heavy a burden for the individual writer. It is part of the meaning of these technical journals' existence that the process of thus communicating scientific thought shall be facilitated as greatly as possible.

This function has been very widely and generously recognized by the publishers of our reputable scientific periodicals in America. It is expressed in the custom of presenting to each substantial contributor a larger or smaller number of separately bound reprints of his article for distribution. Upon the free exchange of monographs which thus becomes possible the scholar depends in no small degree for the equipment of his working library; for this literature, which represents the points of immediate growth in special lines of thought, finds its way only slowly and incompletely into permanent print. It is, therefore, a matter of serious and general importance that these relations between contributor and publisher should be cordially maintained, and the flagrant infraction of them should not remain unknown. ROBERT MACDOUGALL.

NEW YORK UNIVERSITY.

THE SACRAMENTO FORESTS OF NEW MEXICO.

TO THE EDITOR OF SCIENCE: In a communication to your paper dated November 8, 1901,

upon the Sacramento forests of New Mexico, the typist made me say that trees 25 feet in diameter were quite common. It was my intention to say 'trees from two to five feet,' etc.

Robert T. Hill.

SHORTER ARTICLES.

NOTE ON THE EMBRYO OF NYMPHÆA.

Although the mature embryo of *Nymphæa* Sm. has been frequently figured and described during the last half century as typically dicotyledonous, the interesting paper of Mr. Lyon on *Nelumbo (Minnesota Bot. Studies,* Ser. II., Part 5, p. 645–55, Pl. 48–50) made a further investigation desirable. Having already considerable material in hand with a view to a careful study of the genus (which is approaching completion), I have examined the mature and germinating embryos of several species, and studied the development in three members of widely differing sub-genera, viz., *N. odorata* Ait., *N. cærulea* Sav., and *N. Lotus* L. The course of events seems identical in all of these. A suspensor of three to five cells in linear series is formed, upon which a 'spherical embryo' of some hundreds of cells develops as described by Mr. Lyon for *Nelumbo.* This is embedded in a soft mass of endosperm at the micropylar end of the ovule; three fourths of the length of the seed is occupied with perisperm. The spherical embryo, however, unlike that of *Nelumbo,* gives rise to two opposite and symmetrical outgrowths near its lower end. These become the two equal cotyledons. The intervening apical portion of the sphere becomes the plumule, with the rudiments of two unequally developed leaves. The basal portion of the sphere becomes the radicle. At maturity the embryo exhibits two thick, concave, hemispherical cotyledons, applied against each other all round by their edges; while the central concavity is occupied by the plumule. The endosperm is now reduced to a single layer of cells and a line of thin crushed walls between these and the cotyledons. A large amount of oil is stored in the embryo and endosperm, with a little starch and some proteid. The perisperm is densely packed with starch.

It seems necessary, in view of these facts, to modify Mr. Lyon's classification of Nymphæaceæ among the Helobiæ. If we are to consider the development of *Nelumbo* as strictly monocotyledonous, then it must be separated as a distinct order, as some writers have already placed it. However, we would prefer to interpret the peculiar embryogeny of *Nelumbo* as a modified form of dicotyledony. The symmetry of the early embryonic vascular system supports this view; and the decurrence of the cotyledons around the radicle is paralleled in *Tropæolum.* Further, a complete fusion of the cotyledons along one edge has been noted in *Nuphar lutea* by Hegelmaier, as quoted by Henslow, and a much more pronounced 'pseudo-monocotyledony' is seen in *Trapa natans, Ranunculus ficaria,* etc. A number of striking examples and suggestions in this connection are followed up by Henslow in his paper on 'A Theoretical Origin of Endogens from Exogens' in *Journ. Linn. Soc.,* London, 29; 485–528, and in his 'Origin of Plant Structures,' pp. 136–79. Mr. Lyon's observations have numerous interesting bearings on Henslow's theory.

Henry S. Conard.
University of Pennsylvania.

WILLIAM LE ROY BROUN.

Dr. William Le Roy Broun (M.A., LL.D.), president of the Alabama Polytechnic Institute, died suddenly on January 23. He was one of the foremost educators of the country, and, from time to time, had been prominently associated with the leading educational institutions in the South.

In recent years he was conspicuous for the great work he accomplished as a pioneer in the field of technical education. Since 1884 he had been president of the Alabama Polytechnic Institute, and under his wise and progressive guidance this institution had been developed into a highly successful and widely known college of applied science. His death will be an immense loss to the cause of Southern, indeed of national, education.

He was a native of Virginia, born in Lou-

don county, 1827, and a distinguished Master of Arts of the University of Virginia, where he was a fellow student and an intimate friend of a group of prominent Southerners, including Dr. J. A. Broadus, William Wirt Henry, Professor Frank Smith of the University of Virginia, and others. Dr. Broun was graduated in 1850. He was elected to the professorship in the college of Mississippi in 1852 and stayed there two years, then to the chair of mathematics in the University of Georgia.

In 1856 Dr. Broun founded Bloomfield Academy near the University of Virginia, which he conducted successfully until the outbreak of the war between the States. In 1859 he married Miss Sallie J. Fleming, daughter of a prominent Virginia family. She has been dead a number of years.

Dr. Broun enlisted in the Confederate army as a lieutenant of artillery. He rose to the rank of lieutenant colonel in the Ordnance Department, and on account of his high mathematical and scientific attainments was made Commandant of the Arsenal in Richmond. He, perhaps, gave the last order in that city directing the blowing up of the Confederate Arsenal.

After the close of the war Dr. Broun was elected to the chair of physics in the University of Georgia, and in 1872 he became president of the Agricultural and Mechanical College of that University. From 1875 to 1882 he was professor of mathematics in Vanderbilt University, Nashville, Tenn., and in 1882 was elected president of the Agricultural and Mechanical College of Alabama, now known as the Polytechnic Institute. He remained in Auburn one year and went to the University of Texas as professor of mathematics, where he was made chairman of the faculty. In 1884 Dr. Broun was reelected president of the Alabama Polytechnic Institute at Auburn. He had served continuously as president of the institution since 1884.

Dr. Broun was a man of varied and accurate scholarship and of rare wisdom in the control of a great institution. Broadly founded in the principles of educational science, he always planned wisely, and was the first to establish and to develop several new branches of scientific education in the South, such as manual training, electrical engineering and biology.

SCIENTIFIC NOTES AND NEWS.

PLANS have been formed for the erection of a memorial tower and meteorological station in honor of Dr. J. P. Joule, F.R.S., at Sale, Cheshire, where he lived from 1872 to the time of his death in 1880.

DR. ED. SUESS, professor of geology at Vienna, has been made an honorary member of the Academy of Sciences at St. Petersburg.

M. ALFRED PICARD has been elected a member of the Paris Academy of Sciences.

THE Prince of Wales has been admitted as a fellow of the Royal Society.

DR. J. R. GREEN, the well-known botanist, has been elected a fellow of Downing College, Cambridge.

DR. WILHELM HITTORF, professor of physics at Münster, celebrated the fiftieth anniversary of his professorship on January 12. He was on the occasion made an honorary doctor of engineering of the Technical School at Charlottenburg.

THE twenty-fifth anniversary of the professorship of Augusto Tamburini, professor of psychiatry at the University of Modena, was celebrated on December 25, by the presentation of a medal and other ceremonies.

PROFESSOR ERNST VON LEYDEN, the eminent pathologist at the University of Berlin, will celebrate his eightieth birthday on April 20.

DR. KARL PIESKE, engineer in the hydrological bureau in Berlin, has been given the title of 'professor.'

DR. C. H. HERTY, of the University of Georgia, will shortly resign to accept a position in the bureau of forestry.

PROFESSOR A. C. HADDON, of Cambridge University, has been appointed advising curator of the Horniman Museum at Forest Hill, now under the charge of the London County Council.

DR. ADOLF MEYER, the new head of the Pathological Institute of the New York State

Hospitals, has recommended the reappointment of Dr. P. H. Levine as head of the chemical department and of Dr. Brooks as associate in bacteriology.

It is stated in *Nature* that Professor E. Millosevich has succeeded Professor P. Tacchini as director of the Astronomical Observatory of the Roman College and of the astronomical museum connected with it. Professor Tacchini has resigned his office of administrator in the Reale Accademia dei Lincei, and Professor Volterra has been appointed as his successor. Professor P. Villari having been unable to accept the office as president, an election to the presidential chair will be made early in June.

Mr. W. S. Bruce, the leader of the Scottish Antarctic expedition, has secured the services of Captain Thomas Robertson, who for the last twenty years has sailed regularly every spring to the Arctic regions and once to the Antarctic.

Sir W. E. Garstin has started for the Sudan to examine the upper reaches of the Blue Nile and the Atbara. He expects also to visit Lake Tzana, in Abyssinia.

M. Hugues Le Roux, the French explorer and civil engineer, is in the United States for the purpose of delivering lectures. His first lecture in New York will be given on March 18, before the Geographical Society.

The Royal College of Physicians of London has appointed Dr. D. Ferrier, F.R.S., to be Harveian orator, Dr. Cullingworth to be Bradshaw lecturer, and Dr. H. T. Bulstrode to be Milroy lecturer.

Professor Willis L. Moore, chief of the Weather Bureau, lectured at Wesleyan University on February 18, his subject being 'Storm Phenomena.'

The British Association of Technical Institutions held its annual meeting on January 31, when Lord Avebury was elected president for the ensuing year, and delivered an address, in which he dwelt on the neglect of modern languages and science in the system of education.

Dr. H. A. Giles, professor of Chinese at the University of Cambridge, will give a series of lectures at Columbia University, beginning on March 5. They inaugurate the new department of Chinese, established at the University by General Charpentier with an endowment of over $200,000.

The death is announced of Dr. Robert Adamson, professor of logic and rhetoric at Glasgow University and the author of numerous contributions to philosophy, including works on 'Roger Bacon' and on the 'Philosophy of Science in the Middle Ages.'

Dr. C. M. Guldberg, professor of mathematics at Christiania, died on January 14, aged sixty-five years.

Mme. Clémence Royer has died at Paris at the age of seventy-two years. She first became known as the translator of Darwin's 'Origin of Species,' to which she prefixed an important introduction. She was the author of numerous works and articles on philosophy, ethics and natural science.

Dr. Thomas Neall Penrose, medical director, United States Navy, retired, died on February 13, aged sixty-seven years.

Captain Cheyne, R. N., who was present as an officer with the three Arctic expeditions that went in search of Sir John Franklin, has died in Halifax, N. S., on February 9, in his seventy-fifth year.

Mr. Alfred William Bennett, a well-known English botanist, died on January 23. According to a notice in the London *Times* he was born at Clapham, in 1833, and was educated at University College, London. The first of his more important contributions to scientific literature was editing, with Mr. Thiselton Dyer, the English edition of Sachs's 'Textbook of Botany,' 1875; in 1889 he published, in conjunction with Mr. G. Murray, a 'Handbook of Cryptogamic Botany'; his most popular work was the 'Flora of the Alps,' which appeared about seven years ago. He was a fellow of the Linnean Society and of the Royal Microscopical Society, the *Journal* of which society was edited by him.

In a recent number of Science it was stated that the collection of Aino objects made by

Professor Bashford Dean in Japan was 'purchased' for the American Museum of Natural History. It should have been said that the museum reimbursed Professor Dean for the sum which he advanced in making the purchases, and that he contributes as his share in the collection his field expenses and services.

A BILL appropriating $50,000 to enable Professor John B. Smith of Rutgers College to make experiments for the eradication of mosquitoes has been reported favorably in the New Jersey legislature.

THE position of assistant in pathology with a salary of $840 and of assistant in physiology at a salary of $1,000 in the Bureau of Plant Industry, Department of Agriculture, will be filled by civil service examination on February 26.

A TELEGRAM has been received at the Harvard College Observatory from Professor W. W. Campbell at Lick Observatory stating that Professor Perrine finds that the remarkable coronal disturbance in the Sumatra eclipse was immediately above the prominent and only sunspot visible during eleven days.

AT the meeting of the Connecticut Academy of Sciences on February 12, Professor A. E. Verrill exhibited several remarkable photographs in natural colors, made direct from nature by a new autochromatic process, invented by Mr. A. Hyatt Verrill of New Haven. One of these photographs was a Bermuda landscape in which the beautiful tints of the water, etc., were well brought out. Three other plates were copies of water-color drawings of brilliantly colored Bermuda fishes. The photographic reproduction of these showed accurately all the delicate shades of green, blue, pink, purple, yellow and orange. The intense red colors appear to be the most difficult to render by this process at present, but no doubt this will soon be remedied by further experiments now in progress.

THE third annual Charter Day meeting of the Sigma Xi Society at the University of Nebraska was held on February 14. Professor Samuel Calvin, of the University of Iowa and director of the Iowa Geological Survey, was the guest of the Society at the annual banquet and delivered the annual address on 'Records of the Great Ice Age in the Upper Mississippi Valley.' The lecture, which was illustrated by lantern slides, presented the important discoveries of the speaker on the precise limits and characteristics of the various ice sheets which have been demonstrated as present during the ice age in Iowa and the adjacent States.

Nature reports that at the recent annual general meeting of the Royal Scottish Arboricultural Society, Lord Mansfield said he was authorized to state that it was Mr. Hanbury's intention to appoint a departmental committee to inquire into and report upon the present position and future prospects of forestry and the planting and management of woodlands in the United Kingdom, and to consider whether any further measures might be taken with advantage, either by the provision of further educational facilities or otherwise, for their promotion and encouragement. Mr. Munro-Ferguson, M.P., has been invited and has consented to act as chairman of the committee.

THE London *Times* states that the recent acquisitions to the zoological department of the British Museum of Natural History include the interesting collections made by Sir Harry Johnston in Uganda. The great interest attaching to the discovery of the now celebrated okapi has overshadowed the rest of the collection forwarded to the museum by Sir Harry. It contained, nevertheless, many specimens of considerable scientific interest. Mr. Oldfield Thomas, the mammalogist of the department, has been unable to separate specifically the five-horned giraffe obtained near Mount Elgon from the ordinary North African form. The specimen has unusually developed horns, and on that account is of special interest. The collection of birds, though small in number, was particularly welcome, since it was made up chiefly of big birds, such as vultures, storks and herons. Travelers, as a rule, will not take the trouble to skin and bring home birds of this description. The fishes also proved to be very valuable, as they were the first specimens received from Lakes Victoria and Baringo. They included two specimens new to science, described by Mr. Boulenger.

UNIVERSITY AND EDUCATIONAL NEWS.

It will be remembered that several citizens offered to give the Johns Hopkins University a new site in the northern suburbs, consisting of 176 acres, on condition that a million dollars be raised for the erection of buildings. It is understood that the condition has been withdrawn and that the land will be presented to the University at the celebration on Feb. 22.

Cooper Union, New York City, has received an anonymous gift of $250,000 to be added to the endowment.

The sum of £5,000 has been bequeathed to the Aberdeen University, to be applied to the purposes of the University at the discretion of the senate, by the late Surgeon-General Robert Harvey.

Improvements have been completed in the Rotch Building at Harvard University during the last few months which add largely to its facilities for the study of mining engineering. A gift from J. J. Storrow, '85, has made possible the entire refitting of the laboratory of metallurgical chemistry. A new laboratory, to be known as the 'Simpkins Assay Laboratory,' has been fitted up in a large room in the addition on the east side, and another, the 'Simpkins Metallurgical Laboratory,' which is now being equipped, will occupy the remainder of this section. A large room in the northwest corner of the building is to be used for the study of steel; and a complete set of machinery is being installed for this purpose. The laboratory of metallography has been moved to the old Infirmary Building.

A fire in the anatomical laboratory of the University of Minnesota on January 25, caused a loss of $10,000. The students saved the valuable libraries of Professors Erdman and Reed, but some collections were destroyed.

Professor Victor Vaughan, dean of the Medical College of the University of Michigan, is chairman of a committee composed of representatives from the leading schools of the United States, whose object is to make it possible for a system of credits to be standardized in all these schools, so that a student in any one of them may transfer to any other without loss of standing. The colleges represented on the committee are Michigan, Harvard, Pennsylvania, Johns Hopkins, Columbia and Western Reserve.

It is officially announced that law students in Germany need no longer hold a certificate from a classical gymnasium, but may be graduates of the Realgymnasia or higher Realschulen.

The Dowager-Empress of China has issued an edict which, after pointing out that many Chinese have studied abroad formerly, but that no Manchus have done so, orders the Manchu clan at Court and the generals of eight banners to nominate Manchus of between 15 and 25 to go abroad to study foreign branches of knowledge.

Lord Curzon, the viceroy of India, has appointed a commission to visit the university centers and colleges of India to inquire into their prospects, report on their working, and recommend measures for the improvement of the teaching and the standard of learning. The commission is composed as follows: Mr. T. Raleigh, president; Syad Hossain Bilgrami Nawab; Mr. J. P. Hewett, Secretary to the Home Department; Mr. A. Pedler, Director of Public Instruction in Bengal; Professor A. Bourne, Principal of Madras College; and the Rev. Mr. Mackichan, Principal of Wilson College, Bombay.

Dr. R. W. Hall, at present instructor in biology at Yale University and at the Marine Biological Laboratory at Wood's Holl, has been engaged as instructor in biology at Lehigh University. Mr. E. A. Regestein (Massachusetts Institute, '99) has been appointed instructor in electrical engineering at Lehigh University.

Professor von Krafft-Ebbing is about to retire from the chair of psychiatry at Vienna and will be succeeded by Professor W. von Jauregg.

Mr. W. E. Johnson, of King's College, Cambridge, has been appointed Sidgwick lecturer in moral science.

Dr. Pierre Janet has been elected to the chair of psychology in the Collège de France vacant by the resignation of Professor Th. Ribot.